

AIR QUALITY ASSESSMENT STUDIES CARRIED OUT IN THE ELLIOT LAKE AREA

SECOND ANNUAL REPORT 1981

A COMPILATION OF DATA COLLECTED BY:

THE ONTARIO MINISTRY OF THE ENVIRONMENT
THE ONTARIO MINISTRY OF LABOUR
DENISON MINES LIMITED

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Prepared By:

Technical Support Section
Ministry of the Environment
Northeastern Region

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1.0 SUMMARY

Ambient air quality monitoring was carried out in the Elliot Lake area by Denison Mines Limited, the Ontario Ministry of Labour, and the Ontario Ministry of the Environment during 1981.

Airborne particulates were monitored by Denison Mines Limited and the Ontario Ministry of the Environment, using high volume samplers and dustfall jars, while the Ontario Ministry of Labour monitored radon daughter concentrations using track-etch monitors. Some of the high volume and dustfall samples collected by the Ontario Ministry of the Environment were analyzed for radium²²⁶, lead²¹⁰, total uranium, gross α and β .

Total suspended particulate levels were occasionally above the Provincial 24 hour criterion at several of the townsites in the Elliot Lake area during 1981. Generally mean total suspended particulate levels remained constant or decreased.

Dustfall levels above the monthly Provincial criterion were recorded at several locations during 1981. Yearly mean dustfall levels remained constant or decreased at all but two of the sampling locations during 1981.

2.0 INTRODUCTION

In September of 1981, a report entitled "Air Quality Assessment Studies in the Elliot Lake Area, 1976 to 1980" was published by the Ontario Ministry of the Environment. This was the first in a series of annual reports requested by the Environmental Assessment Board which investigated the environmental impact of the expansion of the uranium mines in the Elliot Lake area.

This second annual report is a compilation of data which was collected during 1981. Air monitoring information collected in the Elliot Lake area before 1981 may be obtained from the above-mentioned report.

During 1981 ambient air quality was monitored by the Ontario Ministry of Labour, Denison Mines Limited and the Ontario Ministry of the Environment.

3.0 MONITORING NETWORK AND SAMPLING TECHNIQUES

3.1 Denison Mines Limited:

Denison Mines Limited collected total suspended particulate data during 1981 using the high volume sampling technique at three locations in the Elliot Lake area (Benner Lake, Esker Lake, and Stollery Lake). The sampling locations are shown on the attached map (Figure 1).

The sampling schedule and filter exposure periods used by Denison Mines Limited for collecting high volume samples varied from that used by the Ontario Ministry of the Environment in that the samplers were operated for seven day continuous time periods instead of the customary 24 hour period, once every 6 days. Hence, the samples obtained by the Company represent average conditions over a 168 hour period while the Ministry results represent a 24 hour average. The Provincial criterion for total suspended particulate matter is expressed as a 24 hour average. The technique used by the Ontario Ministry of the Environment to collect high volume samples is described later on in this text.

3.2 The Ontario Ministry Of Labour

The Ontario Ministry of Labour collected data on outdoor radon daughter concentrations at five locations in the Elliot Lake area during 1981 using the track-etch sampling technique. Sampling locations are shown on the attached map (Figure 1).

Data were collected at the Municipal building in Elliot Lake, and at the Denison, Nordic and Quirke townsites. A short-term survey was also carried out at Lawrence Avenue in Elliot Lake at the Ministry of the Environment's request.

The track-etch monitor for measuring radon daughter concentrations draws in a known volume of air for a 4 to 6 week period. Alpha radiation emitters are trapped on a filter and their subsequent decay results in the etching of a plastic substrate. The number of alpha emissions are then determined and converted to working levels (W.L.).

3.3 The Ontario Ministry Of The Environment

The Ontario Ministry of the Environment collected airborne particulate data in the Elliot Lake area during 1981 using the high volume and dustfall sampling techniques. Samples were collected at nine locations using the dustfall technique and at six locations using the high volume technique. Sampling sites are shown on the attached map (Figure 1). A seventh high volume monitoring site located at the Porridge Lake subdivision has been included on the map but will not be operational until 1983.

3.3.1 Dustfall Sampling

The dustfall jar sampling technique is used to determine the amount of settleable particulate matter in air and hence provides an indication of the amounts of larger dust particles. The particulate mass obtained using this method results mostly from particles in the 25 to 100 micron diameter size range. This sampling technique is subject to considerable variability due to recirculation and loss of material through air currents, and the amount of rainfall during the collection period. This method does however provide a measure of the amount of dust in an area and can be used to identify localized dusting problems.

Dustfall samples can be analyzed for various elements and compounds, the results of which assist in determining the source of particulates collected.

A dustfall collector consists of a polyethylene jar measuring approximately 45 cm high and 15 cm in diameter (see Figure 2). The jar is left exposed to the atmosphere for approximately 30 days, usually secured to a pole from 3 to 5 metres above the ground. The weight of the material collected during the exposure period is determined and results are expressed in g/m²/30 days.

Dustfall jars operated by the Ontario Ministry of the Environment are collected by staff and forwarded to the Ministry of the Environment laboratory in Toronto, where they are analyzed for total dustfall and prepared for radiological analysis. When the sample has been prepared it is sent to the Ontario Ministry of Labour's laboratory for radiological analysis. During 1981, uranium (total) analyses were carried out at both the Ministry of Labour and Ministry of the Environment laboratories and the results listed are an average of the two. Analyses carried out on dustfall samples collected by the Ontario Ministry of the Environment in the Elliot Lake area during 1981 included total dustfall, total uranium, gross α , gross β , radium²²⁶ and lead²¹⁰.

3.3.2 High Volume Sampling:

This sampling method determines the mass concentration of suspended airborne particulate material by drawing a large volume of air over a pre-weighed filter medium. Standard operation of the sampler involves air flow rates of 40 to 60 cubic feet per minute and the use of a Gelman A glass fibre filter (see Figure 3). The sample is collected over a 24 hour interval, midnight to midnight, every six days. In addition to determining the mass concentration of total suspended particulates, the filters in the Elliot Lake area were analyzed for total uranium, gross α , gross β , Lead²¹⁰, and Radium²²⁶.

As was mentioned earlier, Denison Mines Limited operated their high volume monitors on a seven day continuous basis (168 hours). Consequently, the data collected cannot be interpreted with respect to the Provincial 24 hour criterion nor can it be compared to data collected by the Ontario Ministry of the Environment.

High volume samples are collected by Regional staff and sent to the Ministry of the Environment Laboratory for total suspended particulate analysis. The prepared samples are then sent to the Ministry of Labour's laboratory for radiological analysis.

4.0 MONITORING RESULTS

4.1 Denison Mines Limited:

Total suspended particulate data collected by Denison Mines Limited (22 samples) is summarized in Table 1. Geometric means range from 15 to 39 $\mu\text{g}/\text{m}^3$ with a maximum seven day value of 82 $\mu\text{g}/\text{m}^3$ recorded at the Stollery Lake site. Although none of the samples collected were above the Ministry's 24 hour criterion of 120 $\mu\text{g}/\text{m}^3$, the sampling technique used by Denison Mines does not conform to that outlined by the Ontario Ministry of the Environment and therefore these results are not comparable.

4.2 The Ontario Ministry Of Labour:

Outdoor concentrations of radon daughters collected in the Elliot Lake area (35 samples) during 1981 are presented in Tables 2 to 6.

Concentration of radon daughters, in working levels, ranged from 0.0004 to 0.0010 at the Municipal building in Elliot Lake, 0.0006 to 0.0014 at the Denison Townsite, 0.0004 to 0.0052 at Nordic Townsite and 0.0014 to 0.0170 at Quirke Townsite.

Concentrations ranged from 0.0007 to 0.0011 at Lawrence Avenue in Elliot Lake for samples collected from November 21, 1981 to March 5, 1982.

None of the samples collected by the Ontario Ministry of Labour during 1981 exceeded the Atomic Energy Control Board's criterion for radon daughters inside buildings of 0.02 working levels. At the present time, there are no guidelines or criteria for ambient outdoor concentrations of radon daughters.

4.3 The Ontario Ministry Of The Environment:

4.3.1 Dustfall:

4.3.1.1 Total Dustfall

Total dustfall data collected at each station in the Elliot Lake area from 1976 to 1981 are summarized in Figures 4 to 13 and in Table 7. Data reported have been included in order to indicate trends in dustfall levels in the area. A total of 103 samples were collected in 1981.

Dustfall levels exceeded the yearly criterion of 4.6 g/m²/30days at Stanrock tailings (SE) and Nordic tailings (S) sites in 1981. The monthly criterion of 7.0 g/m²/30days was exceeded at five of the sampling locations during the year with the Stanrock tailings (SE) site having the greatest number of exceedances (5) during the year.

Generally, dustfall levels have been variable in the Elliot Lake area since 1976. In many cases, this variability can be attributed to the level of construction activity or vehicular traffic both on and off road in the area of some of the monitors.

4.3.1.2 Uranium In Dustfall

At present, the Ontario Ministry of the Environment has no criterion for total uranium in dustfall; however, the analysis can be used for indicating trends in air quality as a function of location and time. Uranium levels in dustfall collected in the Elliot Lake area from April to December, 1981 are included in Table 8 and Figures 14 to 22. Analysis results range from non-detectable to a maximum value of $7.4\text{mg/m}^2/30\text{days}$. Mean values ranged from 0.1 to $1.9\text{ mg/m}^2/30\text{days}$ for the 9 month period, with the highest mean value being recorded at Quirke Townsite and the lowest at Roman Avenue in Elliot Lake, Stanrock Tailings (E) and Stanrock Tailings (NW).

4.3.1.3 Gross α In Dustfall

The Ontario Ministry of the Environment has no criterion for gross α in dustfall. However, gross α in dustfall ranged from a low of <1.7 to 12,180 $\text{mBq/m}^2/30\text{days}$. Results of gross α monitoring are included in Table 9. The highest concentration was recorded at Hillside Drive in Elliot Lake during the month of April and the lowest at Stanrock and Nordic tailings in November.

4.3.1.4 Lead²¹⁰ in Dustfall

The Ontario Ministry of the Environment has no criterion for lead²¹⁰ in dustfall; however, analyses were conducted in 1981 to establish a data base in order to determine future trends. Lead²¹⁰ analyses were carried out during April and May of 1981. These results are included in Table 10. Analysis results ranged from 18.2 to 681 mBq/m²/30days with the highest reading recorded at Kilborne Way in the Town of Elliot Lake during April and the lowest at the Quirke townsite in May.

4.3.1.5 Radium²²⁶ in Dustfall

At the present time the Ministry of the Environment has no criterion for Radium²²⁶ in dustfall; however, Radium²²⁶ analyses in dustfall was carried out for a total of five months in the Elliot Lake area during 1981. Results have been included in Table 11. Analysis results range from a high of 200 mBq/m²/30days at Stanrock Tailings in April to a low of <1.7 mBq/m²/30 days at Nordic Tailings, Quirke Townsite and Denison Townsite in November.

4.3.1.6 Gross β In Dustfall

The Ontario Ministry of the Environment has no criterion for gross β in dustfall. Gross β analyses were carried out on dustfall samples for five months during 1981. Results are included in Table 12. Generally, readings were lower at stations during December and highest in April. Readings ranged from a high of 14,160 at Hillside Drive to <1.9 mBq/m²/30days at the three Elliot Lake sites in December.

4.3.2 High Volume Sampling

4.3.2.1 Total Suspended Particulate

Total suspended particulate data collected in the Elliot Lake area during 1981 are presented in Table 13 and Figures 23 to 28. Data collected before 1981 are also included in the figures for comparison purposes.

Total suspended particulate levels were below the annual criterion of 60 $\mu\text{g}/\text{m}^3$ (geometric mean) at all sampling locations in the Elliot Lake area. The 24 hour criterion of 120 $\mu\text{g}/\text{m}^3$ was exceeded twice at Hillside Drive in Elliot Lake, once at Quirke Townsite and three times at Stollery Lake park in 1981. The maximum 24 hour value of 501 $\mu\text{g}/\text{m}^3$ was recorded at the

Stollery Lake Park, with a maximum value of 164 $\mu\text{g}/\text{m}^3$ being recorded at Hillside Drive in Elliot Lake and at Quirke Townsite.

At the Denison Townsite, the levels of TSP in 1980 and 1981 (see Figure 23) were lower than in previous years for which data are available, whereas at the Quirke Townsite (see Figure 24), annual geometric mean TSP levels have remained fairly constant ranging from about 20 to 30 $\mu\text{g}/\text{m}^3$. At the Hillside Drive site in the town of Elliot Lake, annual TSP levels have been steadily increasing (see Figure 25) since 1976, peaking in 1979 at 56 $\mu\text{g}/\text{m}^3$. At the Nordic Townsite, annual mean TSP levels have remained fairly constant and low ranging from about 15 to 20 $\mu\text{g}/\text{m}^3$ (see Figure 26).

4.3.2.2 Total Uranium In Suspended Particulate

The Ontario Ministry of the Environment has no criterion for total uranium in suspended particulate. Results of total uranium analysis in total suspended particulate for 1981 are summarized in Table 14 and Figure 29. The highest level for total uranium (0.124 $\mu\text{g}/\text{m}^3$) in the Elliot Lake area was measured at the Denison Townsite. The highest annual arithmetic mean of 0.013 $\mu\text{g}/\text{m}^3$ was also recorded at the same location. Figure 29 compares mean uranium levels at all monitoring locations in the Elliot Lake area during 1981.

4.3.2.3 Gross β In Suspended Particulate

The Ontario Ministry of the Environment has no criterion for gross β in total suspended particulate. Gross β in total suspended particulate analysis results are summarized in Table 15 and Figure 30. Figure 30 compares mean gross β analysis at sampling locations in the Elliot Lake area during 1981. The maximum value of 0.65 pci/m³ and the highest mean of 0.123 pci/m³ were recorded at the Quirke Townsite.

4.3.2.4 Gross α in Suspended Particulate

The Ontario Ministry of the Environment has no criterion for gross α in suspended particulate. Gross α in total suspended particulate results are summarized in Table 16. Data are only available for Hillside Drive in Elliot Lake where a maximum value of 2.58 μ Bq/m³ and a mean value of 0.71 μ Bq/m³ were measured.

4.3.2.5 Lead²¹⁰ in Suspended Particulate

The Ontario Ministry of the Environment has no criterion for Lead²¹⁰ in suspended particulate. Lead²¹⁰ in total suspended particulate results are

presented in Table 17. Results for Hillside Drive in Elliot Lake showed a maximum value of 16.91 $\mu\text{Bq}/\text{m}^3$ and a mean value of 0.49 $\mu\text{Bq}/\text{m}^3$. Results for other locations are not available at this time.

4.3.2.6 Radium²²⁶ in Suspended Particulate

The Ontario Ministry of the Environment has no criterion for Radium²²⁶ in suspended particulate. A summary of Radium²²⁶ in suspended particulate is presented in Table 18. Analysis results for Hillside Drive in Elliot Lake showed a mean of 0.26 $\mu\text{Bq}/\text{m}^3$ with a maximum value of 1.23 $\mu\text{Bq}/\text{m}^3$.

5.0 FUTURE MONITORING PROGRAM

The Ontario Ministry of the Environment will continue to monitor ambient air quality in the Elliot Lake area during 1982 and will publish this information in an annual report.

In addition to the six high volume monitors presently being operated in the area, a seventh monitor will begin operation at the Porridge Lake subdivision early in 1983. Radionuclide analyses of total suspended particulates will be compared with data being collected at other locations in the Northeastern Region. Radionuclide data collected during 1981 which was not available for this report will also be included in 1982 annual report.

The nine existing dustfall monitors will continue to operate. Because of the problems arising with quantitative radionuclide analyses of dustfall, this portion of the survey may be discontinued.

Meteorological data from the newly-installed facilities on the mid-Canada Communications tower will be available for inclusion in the 1982 annual report.

6.1 APPENDIX A

DENISON MINES LIMITED
AMBIENT AIR QUALITY
MONITORING DATA

1981

TABLE 1 - Summary of Total Suspended Particulate Data Collected During 1981
in the Elliot Lake Area by Denison Mines Limited

Location	No. of Samples	Geometric Mean ($\mu\text{g}/\text{m}^3$)	Max. 7 Day Value ($\mu\text{g}/\text{m}^3$)
Benner Lake	9	15	23
Esker Lake	8	35	52
Stollery Lake	5	39	82

Samples were collected over continuous seven day periods, and hence cannot be assessed with respect to existing Provincial criteria.

6.2 APPENDIX B

THE ONTARIO MINISTRY OF LABOUR

AMBIENT AIR QUALITY

MONITORING DATA

1981

TABLE 2

Outdoor Concentration of Radon Daughters

at Municipal Building - Elliot Lake

Collected by the Ontario Ministry of Labour

Period	Radon Daughters (WL)
January 23 - February 24, 1981	0.0006
February 24 - March 31, 1981	0.0006
May 25 - July 1, 1981	0.0005
July 1 - July 27, 1981	0.0004
August 12 - September 18, 1981	0.0009
September 18 - October 29, 1981	0.0010
October 29 - December 4, 1981	0.0010
December 4, 1981 - January 7, 1982	0.0009

TABLE 3

Outdoor Concentration of Radon Daughters

at Denison Townsite

Collected by the Ontario Ministry of Labour

Period	Radon Daughters (WL)
March 11 - April 21, 1981	0.0008
April 21 - May 25, 1981	0.0030
June 3 - July 1, 1981	0.0009
July 16 - August 12, 1981	0.0006
August 12 - September 1, 1981	0.0014
October 2 - November 5, 1981	0.0006
November 5 - December 16, 1981	0.0007
December 16, 1981 - January 28, 1982	0.0010

TABLE 4

Outdoor Concentration of Radon Daughters

at Nordic Townsite

Collected by the Ontario Ministry of Labour

Period	Radon Daughters (WL)
January 23 - February 24, 1981	0.0008
February 24 - April 3, 1981	0.0004
April 5 - May 1, 1981	0.0040
May 25 - July 1, 1981	0.0016
July 1 - July 28, 1981	0.0024
July 28 - September 4, 1981	0.0052
October 2 - October 29, 1981	0.0034
October 29 - December 4, 1981	0.0024
December 4, 1981 - January 7, 1982	0.0010

TABLE 5

Outdoor Concentration of Radon Daughters

at Quirke Townsite

Collected by the Ontario Ministry of Labour

Period	Radon Daughters (WL)
January 23 - February 24, 1981	0.0014
February 24 - April 3, 1981	0.0019
June 3 - July 3, 1981	0.0066
July 3 - July 28, 1981	0.0095
July 28 - August 24, 1981	0.0170
September 22 - October 23, 1981	0.0030
November 20 - December 31, 1981	0.0027

TABLE 6 Outdoor Concentration of Radon Daughters
at 1 Lawrence Avenue, Lakeside Estates, Elliot Lake
Collected by the Ontario Ministry of Labour

Period	Radon Daughters (WL)
November 24, 1981 to January 7, 1982	0.0007
January 7, 1982 to February 5, 1982	0.0011
February 5, 1982 to March 5, 1982	0.0011

6.3 APPENDIX C

**THE ONTARIO MINISTRY OF THE ENVIRONMENT
AMBIENT AIR QUALITY
MONITORING DATA**

1981

TABLE 7 - Summary of Total Dustfall Data in the Elliot Lake Area from 1976 - 1982
Collected by the Ontario Ministry of the Environment

<u>Location</u>	<u>No. of Samples Collected</u>						<u>Arithmetic Mean of Dustfall Levels (gm/m²/30 days)</u>						<u>Maximum Value (gm/m²/30 days)</u>						<u>No. of Samples Above Provincial Criterion</u>															
	<u>1976</u>		<u>1977</u>		<u>1978</u>		<u>1979</u>		<u>1980</u>		<u>1981</u>		<u>1976</u>		<u>1977</u>		<u>1978</u>		<u>1979</u>		<u>1980</u>		<u>1981</u>		<u>1976</u>		<u>1977</u>		<u>1978</u>		<u>1979</u>		<u>1980</u>	
	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>				
Hillside Drive, Elliot Lake (71020)	5	11	12	12	11	12	3.5	3.5	2.8	7.0	4.2	4.2	4.6	7.5	4.9	23.4	8.7	10.2	0	1	0	3	2	2	0	1	0	2	1	2				
Kilborn Way, Elliot Lake (71028)	5	10	10	12	11	11	2.7	3.4	3.9	4.8	3.7	2.8	4.2	6.5	10.6	11.5	7.4	7.5	0	0	0	2	2	1	1	0	0	2	1	1				
Roman Ave., Elliot Lake (71029)	2	10	11	11	11	12	2.0	3.6	2.5	2.1	2.8	3.1	2.8	17.7	5.8	2.8	3.9	6.2	0	1	0	0	0	0	0	0	0	0	0	0				
Stanrock Tailings (E) (71026)	1	9	11	12	11	11	--	2.4	1.7	2.1	2.4	2.4	0.7	6.2	4.2	5.1	4.2	1.6	0	0	0	0	0	0	0	0	0	0	0	0				
Stanrock Tailings (NW) (71027)	5	11	12	12	11	12	2.2	2.1	1.5	1.2	2.2	1.6	4.2	4.9	3.1	2.1	9.8	5.8	0	0	0	0	0	1	0	0	0	1	0					
Stanrock Tailings (SE) (71052)	--	5	12	12	11	10	--	4.0	4.6	6.7	8.4	5.5	--	8.6	11.5	14.0	22.3	12.8	--	1	2	5	5	5	1	2	5	5	5					
Nordic Tailings (S) (71025)	1	11	12	11	11	11	--	2.4	2.1	2.4	2.1	5.1	1.1	5.3	5.6	4.7	3.6	20.8	0	0	0	0	0	0	0	0	0	0	2					
Nordic Tailings (SE) (71050)	--	5	12	12	11	--	--	6.3	5.1	4.3	3.2	--	--	14.0	14.5	8.8	11.9	--	--	2	3	3	1	--	2	3	3	1	--					

TABLE 7 (Continued)

<u>Location</u>	<u>No. of Samples Collected</u>						<u>Arithmetic Mean of Dustfall Levels (gm/m²/30 days)</u>						<u>Maximum Value (gm/m²/30 days)</u>						<u>No. of Samples Above Provincial Criterion</u>					
	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>
Quirke Townsite (71023)	5	11	12	12	11	12	1.8	2.0	1.8	1.6	2.3	2.1	2.8	4.3	3.8	2.6	3.9	6.8	0	0	0	0	0	0
Denison Townsite (71024)	5	11	11	12	10	12	4.5	9.0	4.8	7.7	2.7	2.9	9.1	24.1	11.2	25.5	5.1	9.6	1	6	3	3	0	1
TOTAL	29	94	115	118	109	103													1	11	10	16	10	11

Provincial Criterion - 7.0 gm/m²/30 days (30 day period)
 - 4.6 gm/m²/30 days (1 year period)

TABLE 8 - Summary of Total Uranium in Dustfall ($\text{mg/m}^2/30\text{days}$) in the Elliot Lake Area for the Period of April 1981 to December 1981
 Collected by the Ontario Ministry of the Environment

	<u>April</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>August</u>	<u>Sept.</u>	<u>Oct.</u>	<u>Nov.</u>	<u>Dec.</u>	<u>Max. Value</u>	<u>Arith. Mean</u>
Hillside Drive, Elliot Lake (71020)	7.4	<0.1	<0.1	<0.1	<0.1	0.5	0.1	<0.1	<0.1	7.4	0.9
Quirke Townsite (71023)	5.4	.1	7.4	.2	.1	3.3	.1	.1	<0.1	7.4	1.9
Denison Townsite (71024)	0.6	0.3	0.6	0.4	0.8	0.4	0.2	0.1	<0.1	0.8	0.4
Nordic Tailings (71025)	<0.1	<0.1	0.2	0.1	<0.1	1.2	0.1	0.1	<0.1	1.2	0.2
Stanrock Tailings (NW) (71027)	0.6	<0.1	0.1	0.1	<0.1	0.1	0.1	<0.1	<0.1	0.6	0.1
Kilborn Way, Elliot Lake (71028)	7.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	7.1	0.8
Roman Avenue, Elliot Lake (71029)	0.3	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	0.2	0.3	0.1
Stanrock Tailings (E) (71026)	<0.1	--	0.4	<0.1	<0.1	0.1	<0.1	<0.1	--	0.4	0.1
Stanrock Tailings (SE) (71052)	2.4	<0.1	0.3	<0.1	<0.1	0.1	<0.1	<0.1	--	2.4	0.3

Detection limit is estimated to be $0.1 \text{ mg/m}^2/30\text{days}$

TABLE 9 - Summary of Gross α Analysis in Dustfall in the Elliot Lake Area for 1981
 Collected by the Ontario Ministry of the Environment

<u>STATION #</u>	<u>April</u>	<u>May</u>	<u>MONTH</u> <u>October</u>	<u>November</u>	<u>December</u>
Hillside Drive, Elliot Lake (71020)	12,180	55.6	976	240.1	329
Kilborn Way, Elliot Lake (71028)	3,790	68	25.1	66.4	5.2
Roman Avenue, Elliot Lake (71029)	616	87	1,867	15.3	121.1
Stanrock Tailings (E) (71026)	624	--	808	<1.7	198.5
Stanrock Tailings (NW) (71027)	1,240	279	334	700	222.5
Stanrock Tailings (SE) (71052)	3,280	680	867	311.0	--
Nordic Tailings (S) (71025)	458	41.3	177	<1.7	300
Quirke Townsite (71023)	4,880	242	623	126.3	6.9
Denison Townsite (71024)	748	350	1,080	65.9	65.4

Units - mBq/m²/30 days
 No Provincial Criterion

TABLE 10 - Summary of Lead²¹⁰ Analysis in Dustfall in the Elliot Lake Area for 1981
 Collected by the Ontario Ministry of the Environment

<u>STATION</u>	<u>APRIL</u>	<u>MONTH</u>	<u>MAY</u>
Hillside Drive, Elliot Lake (71020)	523		37.3
Kilborn Way, Elliot Lake (71028)	681		49
Roman Avenue, Elliot Lake (71029)	385		55.2
Stanrock Tailings (E) (71026)	23		22.8
Stanrock Tailings (NW) (71027)	202		---
Stanrock Tailings (SE) (71052)	318		60.6
Nordic Tailings (S) (71025)	200		32.4
Quirke Townsite (71023)	244		18.2
Denison Townsite (71024)	354		32.4

Units - mBq/m²/30 days
 No Provincial Criterion

TABLE 11 - Summary of Radium²²⁶ Analysis in Dustfall in the Elliot Lake Area for 1981
 Collected by the Ontario Ministry of the Environment

<u>Station #</u>	<u>April</u>	<u>May</u>	<u>Month</u>	<u>October</u>	<u>November</u>	<u>December</u>
Hillside Drive, Elliot Lake (71020)	56.3	<5.0		<3.9	4.2	<1.9
Kilborne Way, Elliot Lake (71028)	21	<5.0		50.3	3.9	<1.9
Roman Avenue, Elliot Lake (71029)	<23	9		21.0	2.5	<1.9
Stanrock Tailings (E) (71026)	102	--		3.6	82.9	19.9
Stanrock Tailings (NW) (71027)	200	76.6		<3.9	3.5	<1.9
Stanrock Tailings (SE) (71052)	47.7	183		<3.9	14.3	--
Nordic Tailings (S) (71025)	24	<5.4		<3.9	<1.7	<1.9
Quirke Townsite (71023)	85.2	29		<3.9	<1.7	<1.9
Denison Townsite (71024)	<23	23.9		70.4	<1.7	<1.9

Units - mBq/m²/30 days
 No Provincial Criterion

TABLE 12 - Summary of Gross β Analysis for Dustfall in the Elliot Lake Area for 1981
 Collected by the Ontario Ministry of the Environment

<u>Station #</u>	<u>Month</u>				
	<u>April</u>	<u>May</u>	<u>October</u>	<u>November</u>	<u>December</u>
Hillside Drive, Elliot Lake (71020)	14,160	645	1362	175	<1.9
Kilborn Way, Elliot Lake (71028)	6,590	495	251	78.4	<1.9
Roman Avenue, Elliot Lake (71029)	3,905	505	664	94.7	<1.9
Stanrock Tailings (E) (71026)	4,710	--	477	<1.7	171
Stanrock Tailings (NW)(71027)	4,670	483	514	170	<1.9
Stanrock Tailings (SE) (71052)	6,570	737	1,100	426	--
Nordic Tailings (S) (71025)	2,340	412	1,125	90.4	<1.9
Quirke Townsite (71023)	8,690	657	697	109.5	54.9
Denison Townsite (71024)	3,620	752	1,256	204.5	430

Units - mBq/m²/30 days
 No Provincial Criterion

TABLE 13 - Summary of Total Suspended Particulate Data in the Elliot Lake Area
During 1981 - Collected by the Ontario Ministry of the Environment

Location	No. of Samples	Geometric Mean ($\mu\text{g}/\text{m}^3$)	Maximum 24 Hr. Value ($\mu\text{g}/\text{m}^3$)	No. of Samples above Provincial Criterion (24 Hours)
Hillside Drive, Elliot Lake (71020)	56	42	164	2
Quirke Townsite (71023)	55	31	164	1
Denison Townsite (71053)	58	21	119	0
Nordic Townsite (71054)	53	17	61	0
Esker Lake Camp (71061)	35	28	108	0
Stollery Lake Trailer Park (71063)	34	44	501	3
TOTAL	<u>291</u>			<u>6</u>

Provincial Criterion: Annual - $60 \mu\text{g}/\text{m}^3$ (Geometric Mean)
24 Hour - $120 \mu\text{g}/\text{m}^3$

TABLE 14 - Summary of Uranium in Suspended Particulate in the Elliot Lake Area During 1981
 Collected by the Ontario Ministry of the Environment

Location	Number of Samples Collected	Arithmetic Mean (0.001 µg/m³)	Maximum Value (0.001 µg/m³)
*Hillside Drive, Elliot Lake (71020)	37	0.324	6
*Quirke Townsite (71023)	37	4.703	22
*Denison Townsite (71053)	4	13.175	124
*Nordic Townsite (71054)	35	2.229	17
**Esker Lake Camp (71061)	35	1.629	8
**Stollery Lake Trailer Park (71063)	29	1.655	13

* Sampling Started May 1981

** Sampling Started June 1981

No Provincial Criterion

TABLE 15 - Summary of Gross β Analysis in Suspended Particulate in the Elliot Lake Area During 1981
 Collected by the Ontario Ministry of the Environment

Location	Number of Samples Collected	Arithmetic Mean (0.01 picocurie/m ³)	Maximum Value (0.01 picocurie/m ³)
Hillside Drive, Elliot Lake (71020)	56	8.089	30
Quirke Townsite (71023)	55	12.364	65
Denison Townsite (71053)	58	8.778	35
Nordic Townsite (71054)	53	8.113	37
*Esker Lake Camp (71061)	35	3.343	13
*Stollery Lake Trailer Park (71063)	29	5.431	14

*Sampling began June, 1981.
 No Provincial Criterion.

TABLE 16 - Summary of Gross α Analysis in Suspended Particulate
in the Elliot Lake Area During 1981
collected by the Ontario Ministry of the Environment

Location	No. of Samples Collected	Arithmetic Mean $\mu\text{Bq}/\text{m}^3$	Maximum Value $\mu\text{Bq}/\text{m}^3$
Hillside Drive, Elliot Lake (71020)	22	0.71	2.58

Data from other locations not available at this time.

No Provincial Criterion

TABLE 17 - Summary of Lead²¹⁰ Analysis in Suspended Particulate
 in the Elliot Lake Area During 1981
 Collected by the Ontario Ministry of the Environment

Location	No. of Samples Collected	Arithmetic Mean $\mu\text{Bq}/\text{m}^3$	Maximum Value $\mu\text{Bq}/\text{m}^3$
Hillside Drive, Elliot Lake (71020)	22	0.49	16.91

Data from other locations not available at this time.

No Provincial Criterion

TABLE 18 - Summary of Radium²²⁶ Analysis in Suspended Particulate
 in the Elliot Lake Area During 1981
 Collected by the Ontario Ministry of the Environment

Location	No. of Samples Collected	Arithmetic Mean $\mu\text{Bq}/\text{m}^3$	Maximum Value $\mu\text{Bq}/\text{m}^3$
Hillside Drive, Elliot Lake (71020)	22	0.26	1.23

Data from other locations not available at this time.

No Provincial Criterion

6.4 APPENDIX D

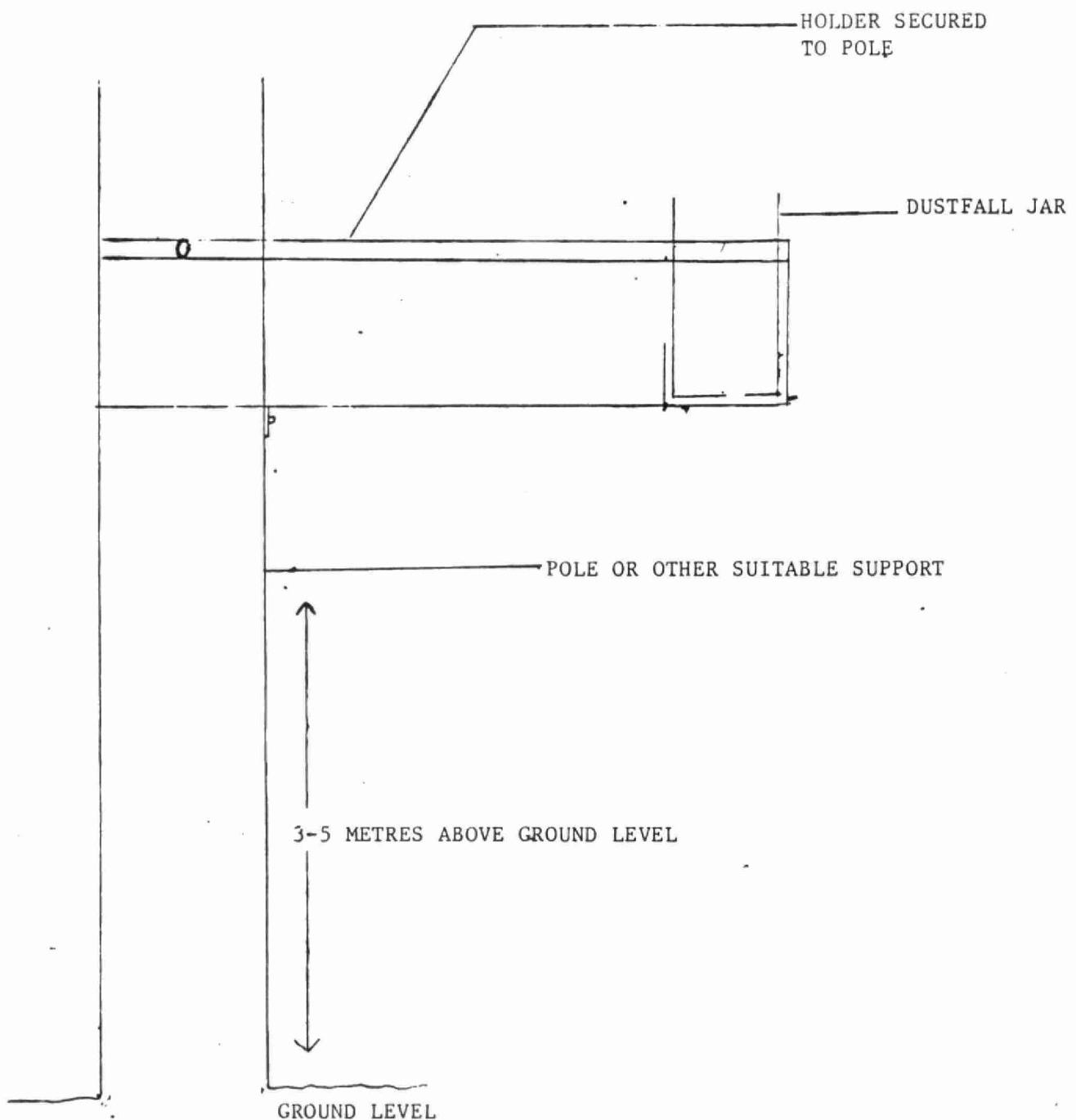
**THE ONTARIO MINISTRY OF THE ENVIRONMENT
AMBIENT AIR QUALITY
MONITORING DATA**

1981

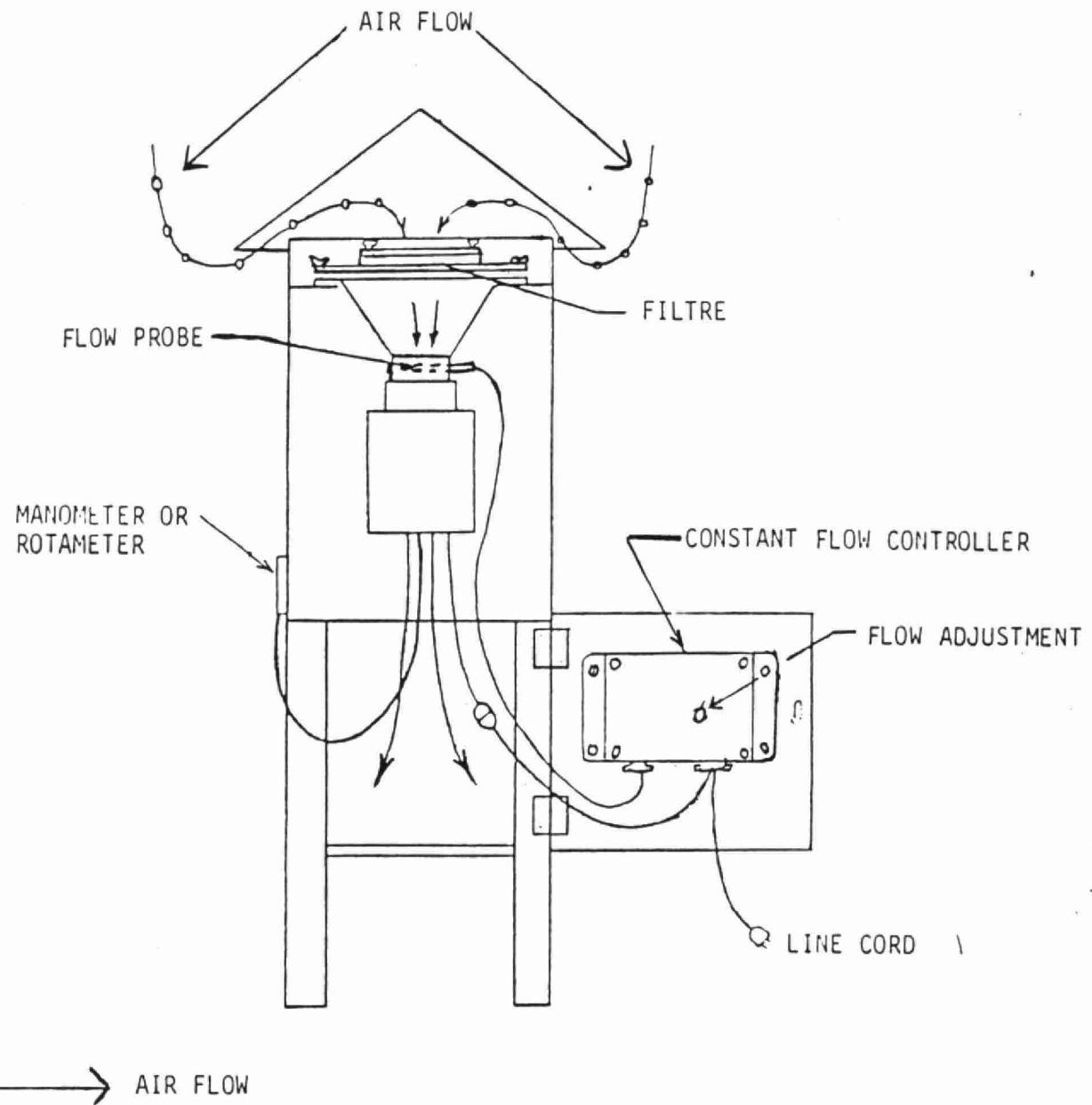
FIGURES

TYPICAL DUSTFALL JAR

(FIGURE 2)



HIGH VOLUME AIR SAMPLER (FIGURE 3)



ANNUAL ARITHMETIC MEAN OF TOTAL DUSTFALL COLLECTED IN THE
ELLiot LAKE AREA

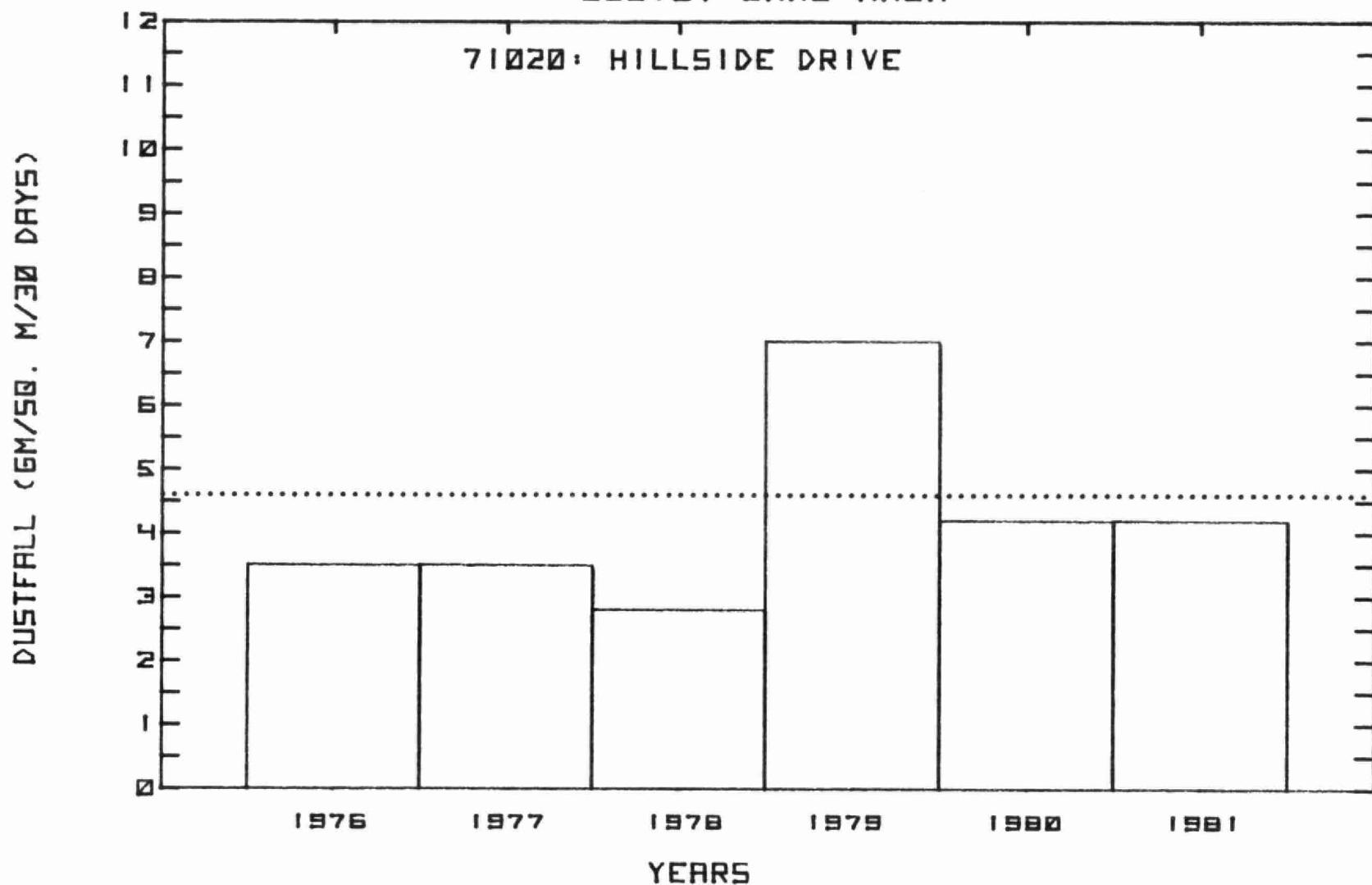


FIG. 4

PERIOD: 1976 TO 1981

.... PROVINCIAL CRITERION -
7.0 GM/50. M/30 DAYS (30 DAY PERIOD)
4.6 GM/50. M/30 DAYS (1 YEAR PERIOD)

ANNUAL ARITHMETIC MEAN OF TOTAL DUSTFALL COLLECTED IN THE
ELLIOT LAKE AREA

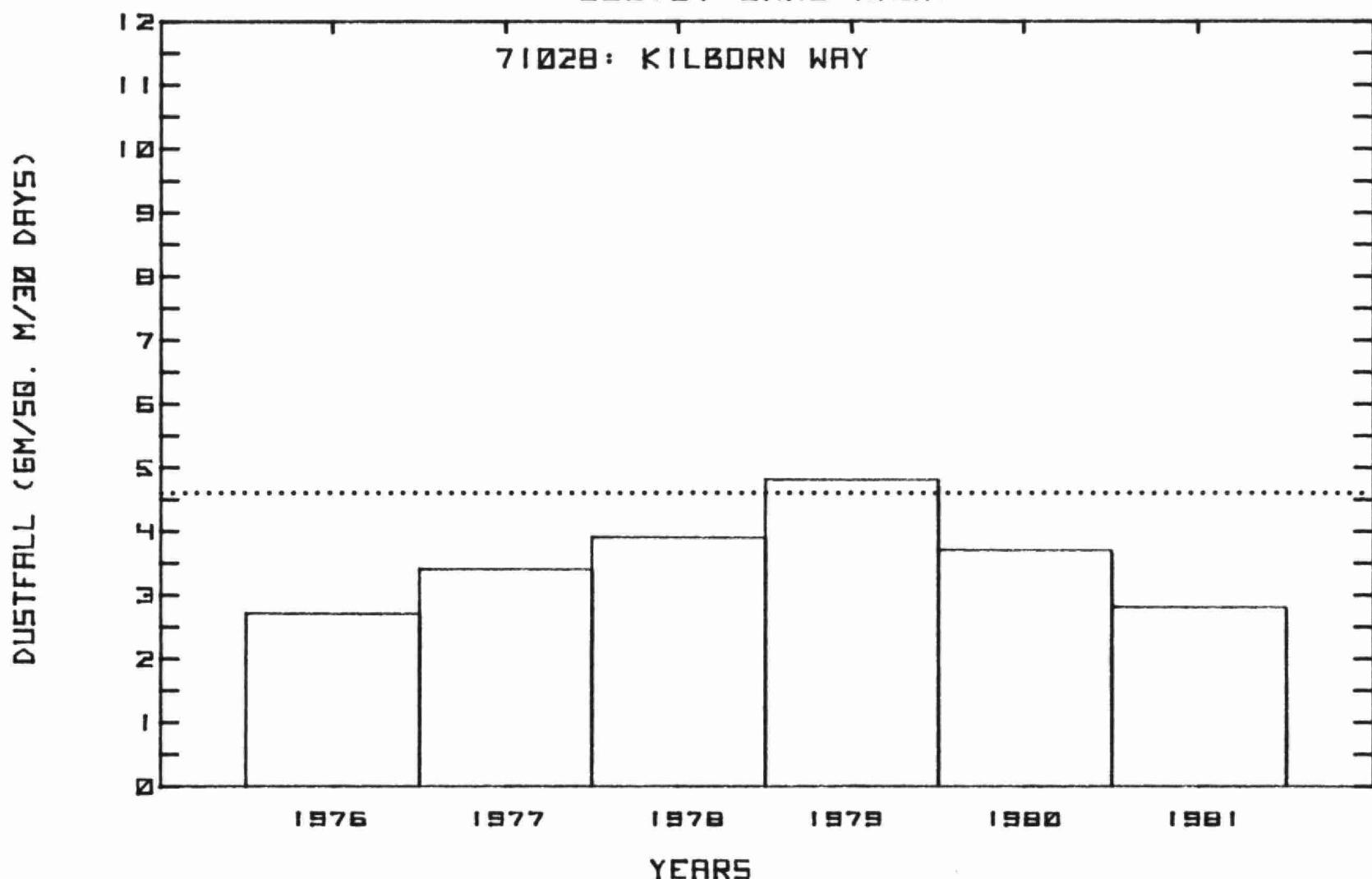


FIG. 5

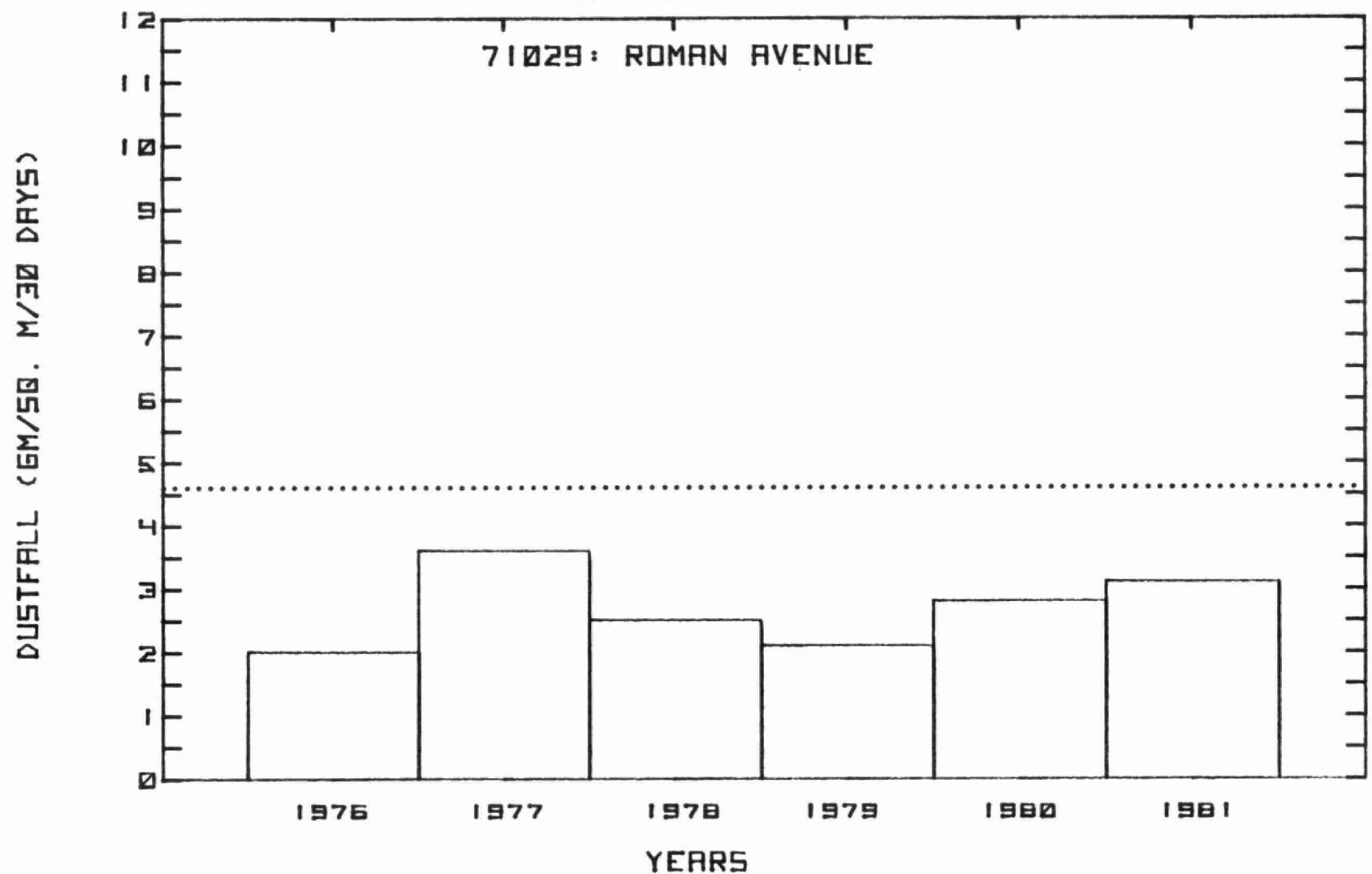
PERIOD: 1976 TO 1981

.... PROVINCIAL CRITERION -

7.0 GM/SQ. M/30 DAYS (30 DAY PERIOD)

4.6 GM/SQ. M/30 DAYS (1 YEAR PERIOD)

ANNUAL ARITHMETIC MEAN OF TOTAL DUSTFALL COLLECTED IN THE
ELLIOT LAKE AREA



.... PROVINCIAL CRITERION -

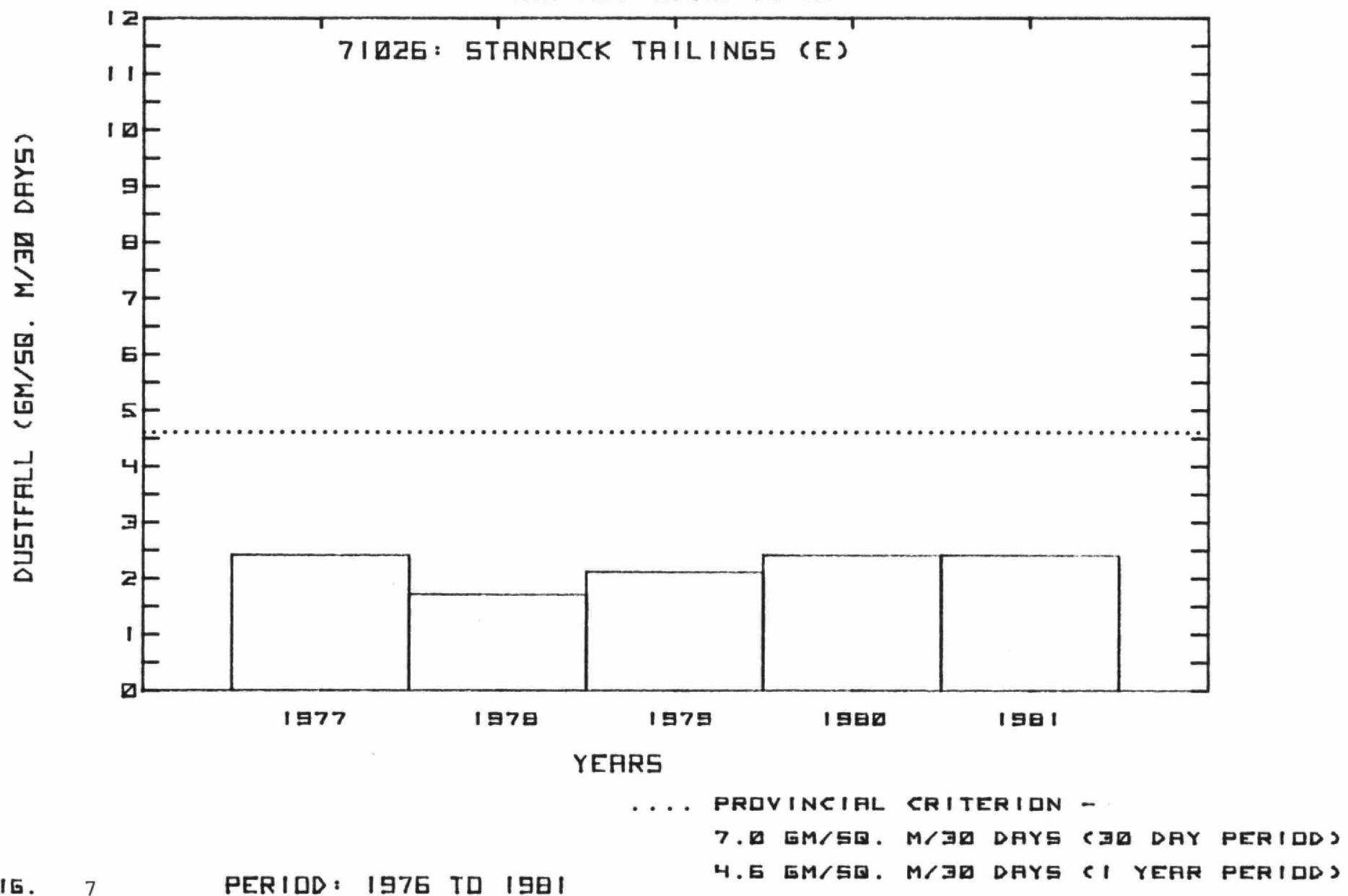
7.0 GM/SQ. M/30 DAYS (30 DAY PERIOD)

4.6 GM/SQ. M/30 DAYS (1 YEAR PERIOD)

FIG. 6

PERIOD: 1976 TO 1981

ANNUAL ARITHMETIC MEAN OF TOTAL DUSTFALL COLLECTED IN THE
ELLIOT LAKE AREA



ANNUAL ARITHMETIC MEAN OF TOTAL DUSTFALL COLLECTED IN THE
ELLIOT LAKE AREA

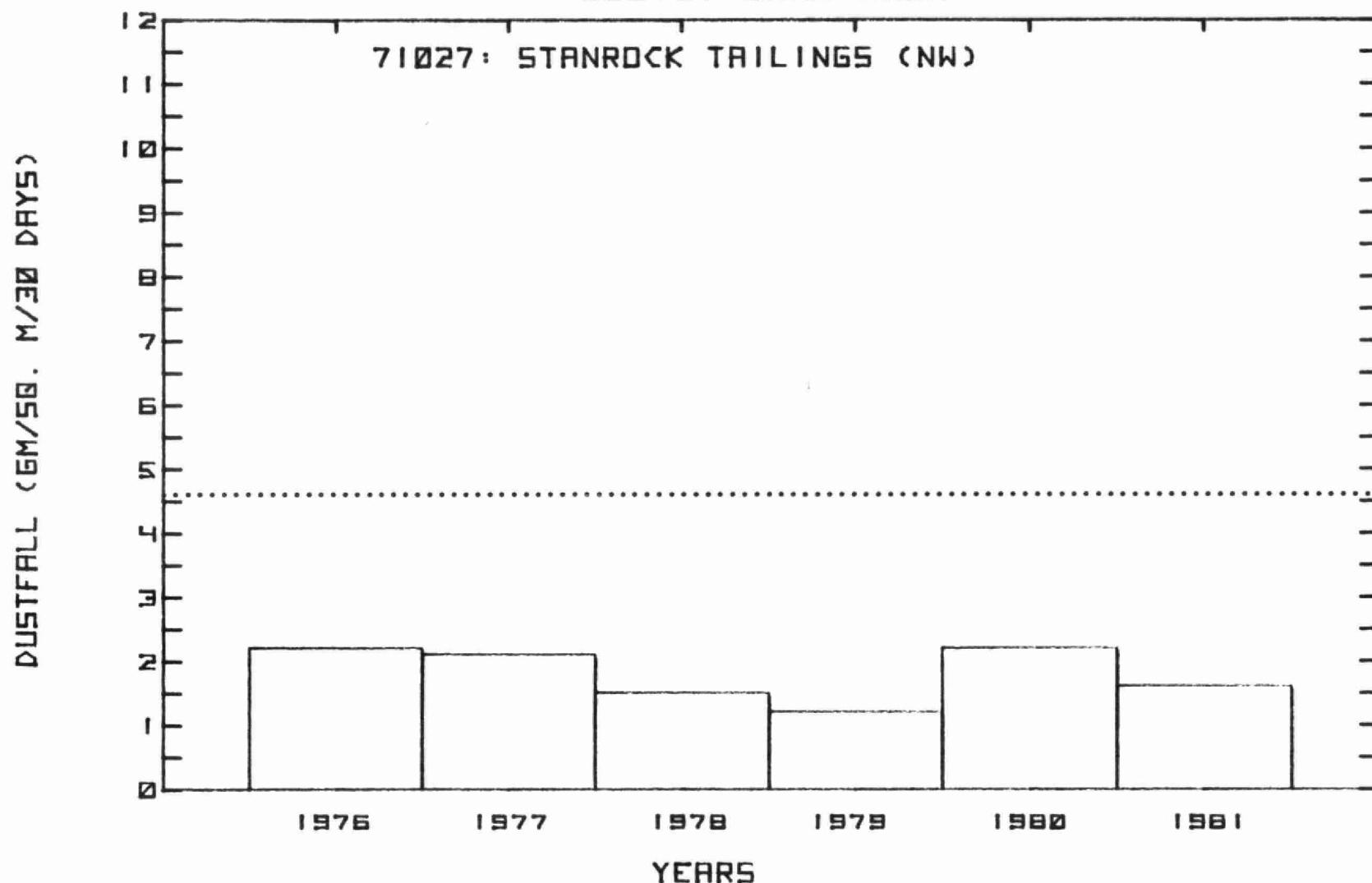


FIG. 8

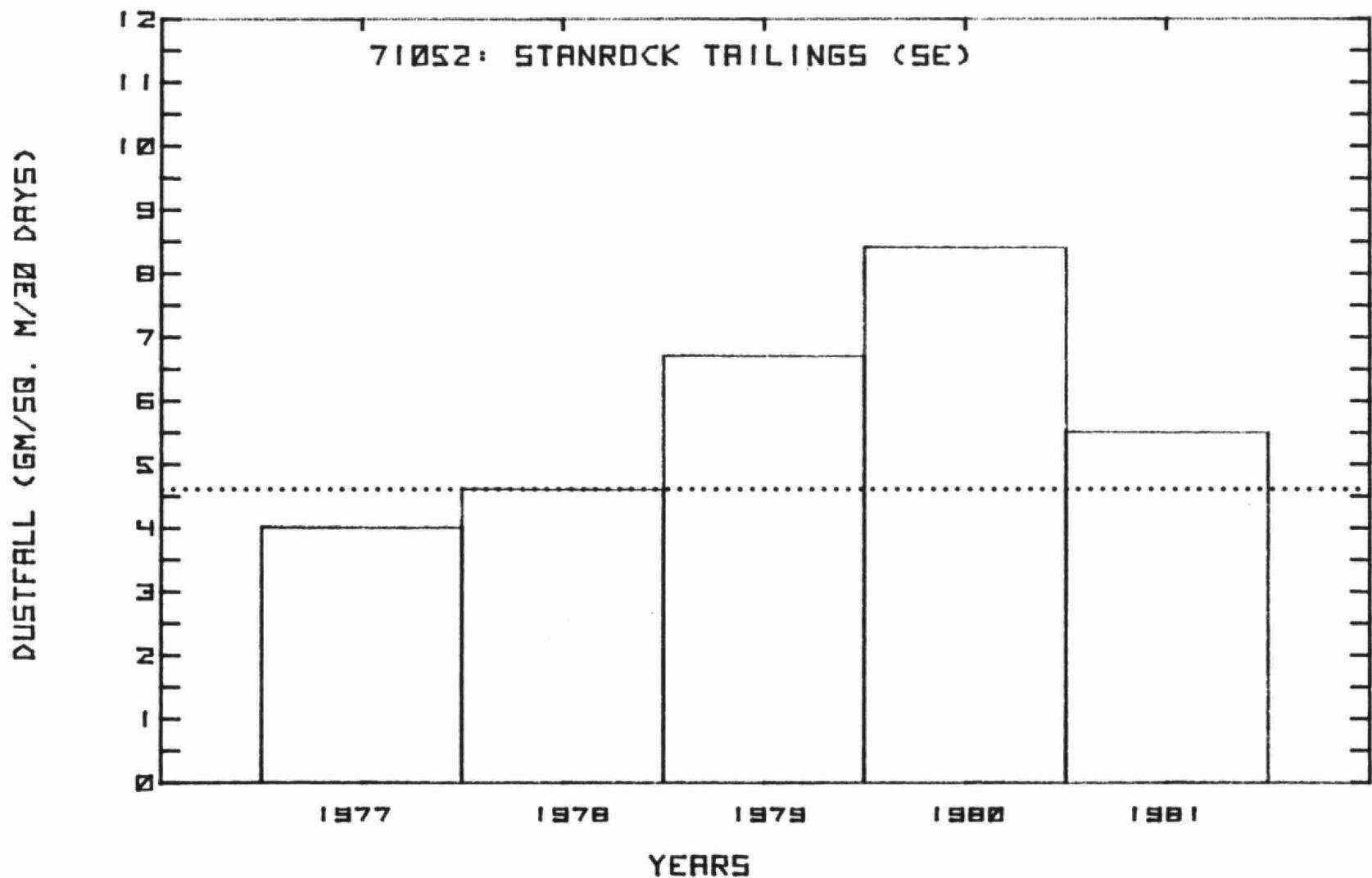
PERIOD: 1976 TO 1981

.... PROVINCIAL CRITERION -

7.0 GM/SQ. M/30 DAYS (30 DAY PERIOD)

4.6 GM/SQ. M/30 DAYS (1 YEAR PERIOD)

ANNUAL ARITHMETIC MEAN OF TOTAL DUSTFALL COLLECTED IN THE
ELLIOT LAKE AREA



..... PROVINCIAL CRITERION -

7.0 GM/SQ. M/30 DAYS (30 DAY PERIOD)

4.6 GM/SQ. M/30 DAYS (1 YEAR PERIOD)

ANNUAL ARITHMETIC MEAN OF TOTAL DUSTFALL COLLECTED IN THE
ELLIOT LAKE AREA

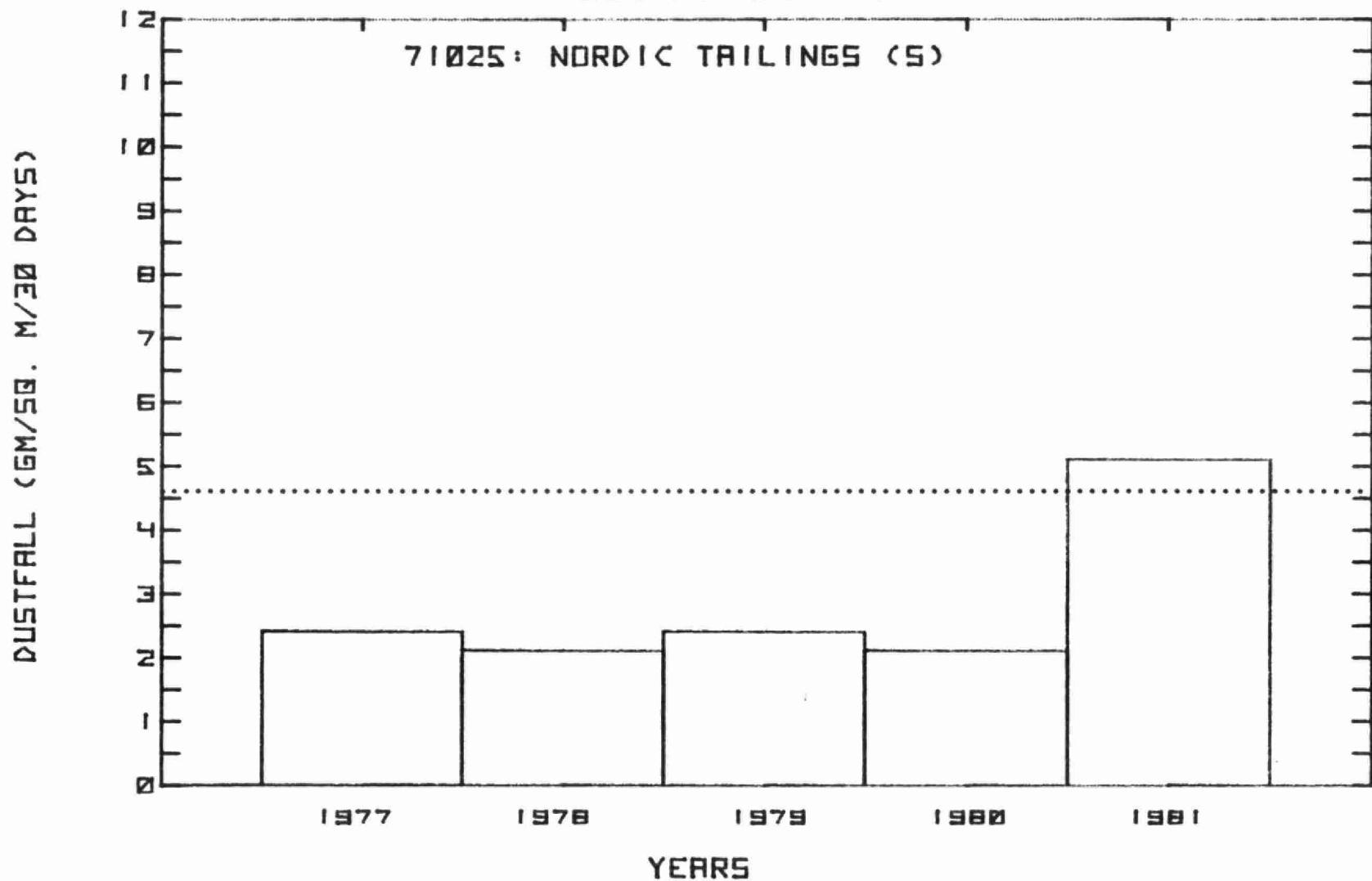


FIG. 10

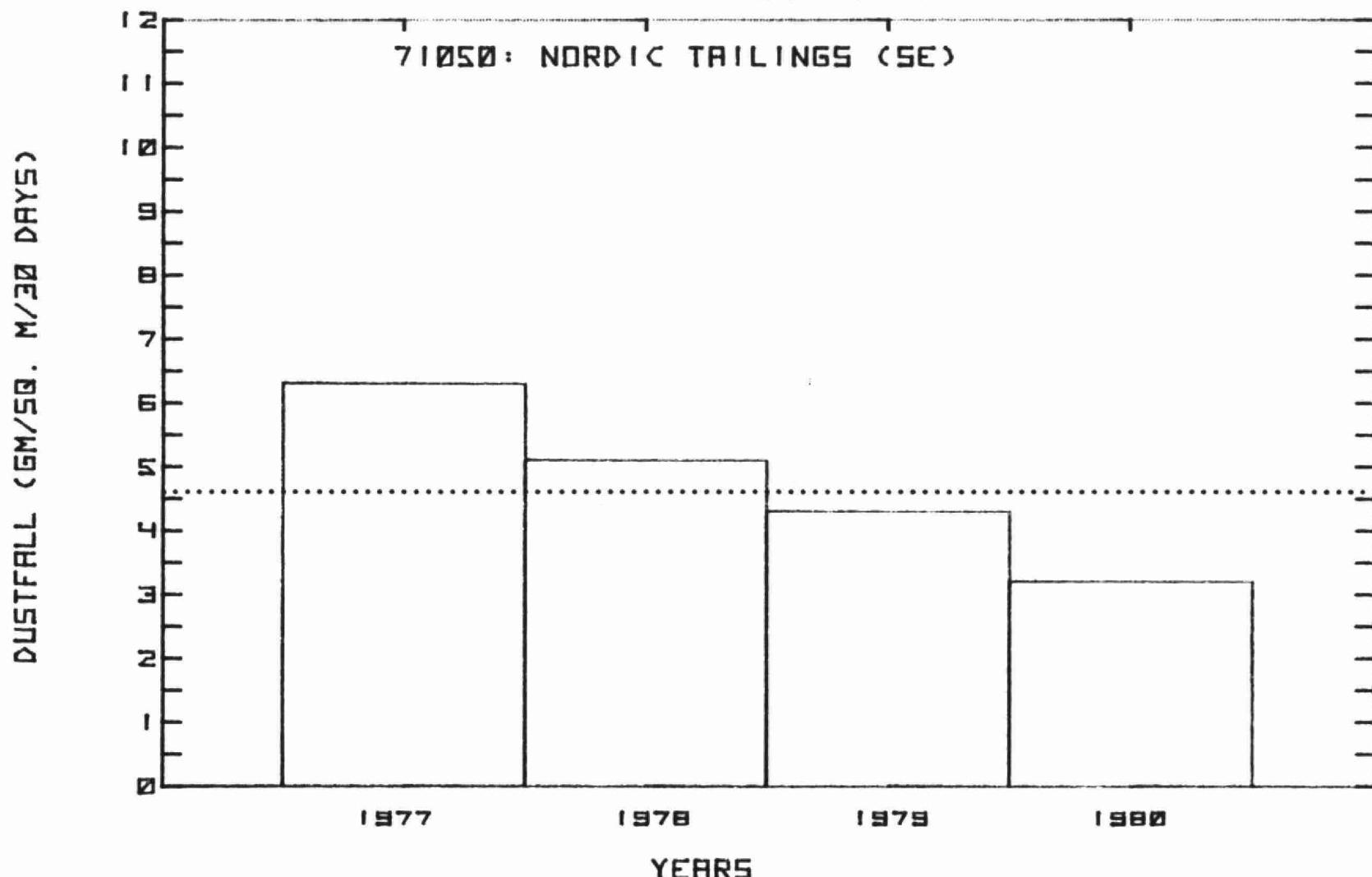
PERIOD: 1977 TO 1981

.... PROVINCIAL CRITERION -

7.0 GM/SQ. M/30 DAYS (30 DAY PERIOD)

4.6 GM/SQ. M/30 DAYS (1 YEAR PERIOD)

ANNUAL ARITHMETIC MEAN OF TOTAL DUSTFALL COLLECTED IN THE
ELLIOT LAKE AREA



.... PROVINCIAL CRITERION -

7.0 GM/SQ. M/30 DAYS (30 DAY PERIOD)

4.6 GM/SQ. M/30 DAYS (1 YEAR PERIOD)

FIG. 11

PERIOD: 1977 TO 1980

ANNUAL ARITHMETIC MEAN OF TOTAL DUSTFALL COLLECTED IN THE
ELLIOT LAKE AREA

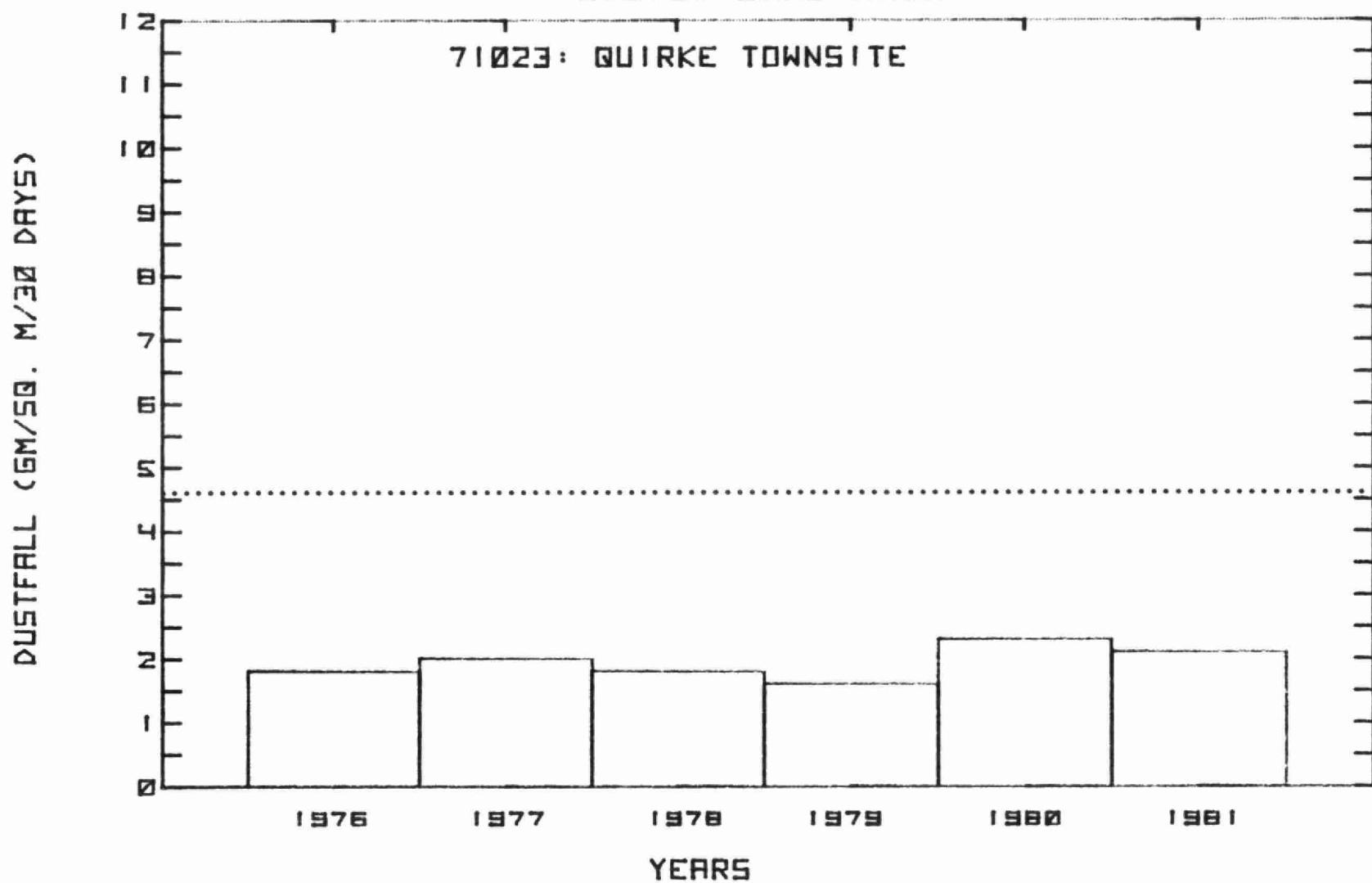


FIG. 12

PERIOD: 1976 TO 1981

.... PROVINCIAL CRITERION -

7.0 GM/SQ. M/30 DAYS (30 DAY PERIOD)

4.6 GM/SQ. M/30 DAYS (1 YEAR PERIOD)

ANNUAL ARITHMETIC MEAN OF TOTAL DUSTFALL COLLECTED IN THE
ELLIOT LAKE AREA

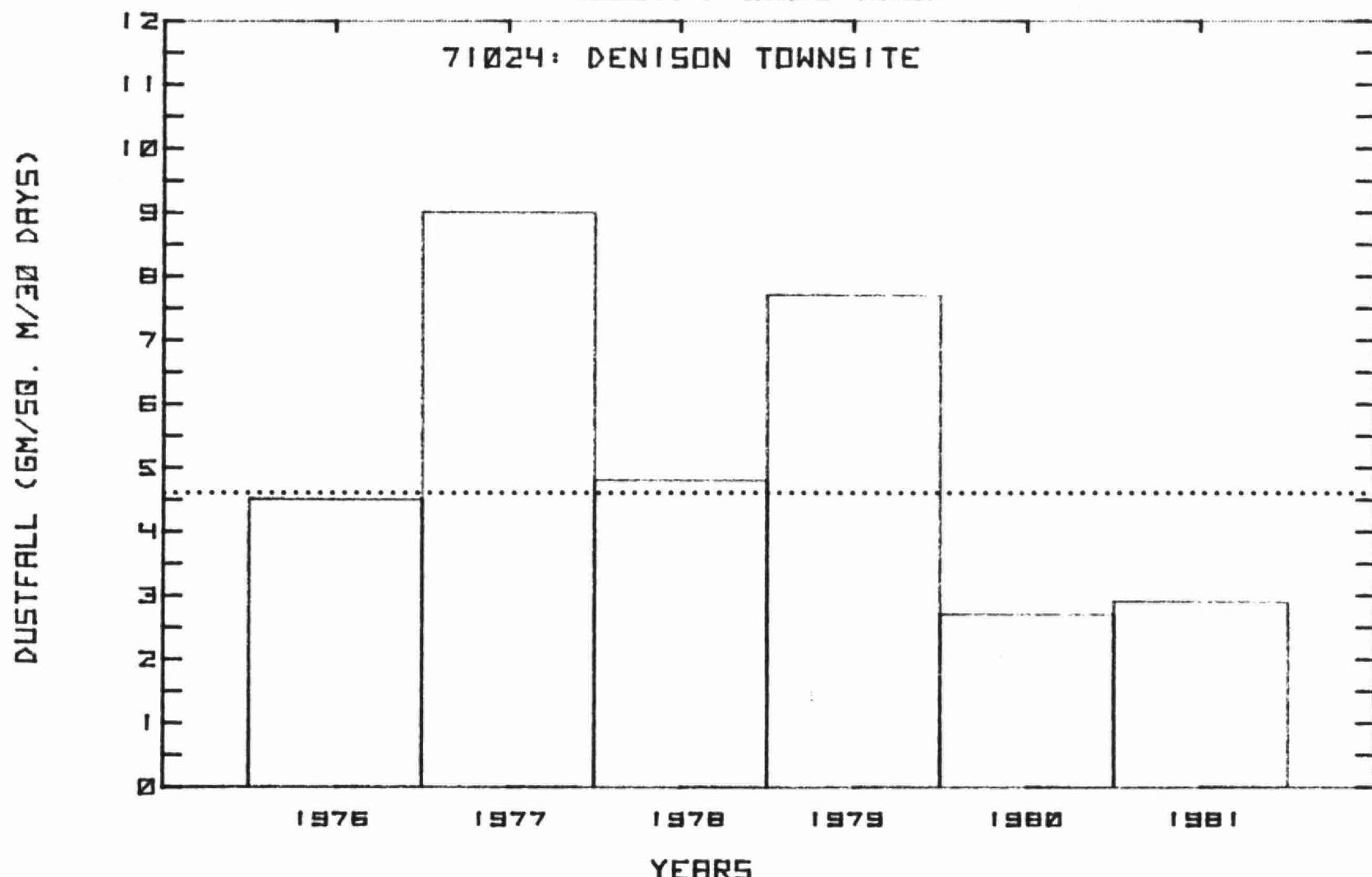


FIG. 13

PERIOD: 1976 TO 1981

.... PROVINCIAL CRITERION -

7.0 GM/SQ. M/30 DAYS (30 DAY PERIOD)

4.6 GM/SQ. M/30 DAYS (1 YEAR PERIOD)

URANIUM IN DUSTFALL FOR THE ELLIOT LAKE AREA, 1981

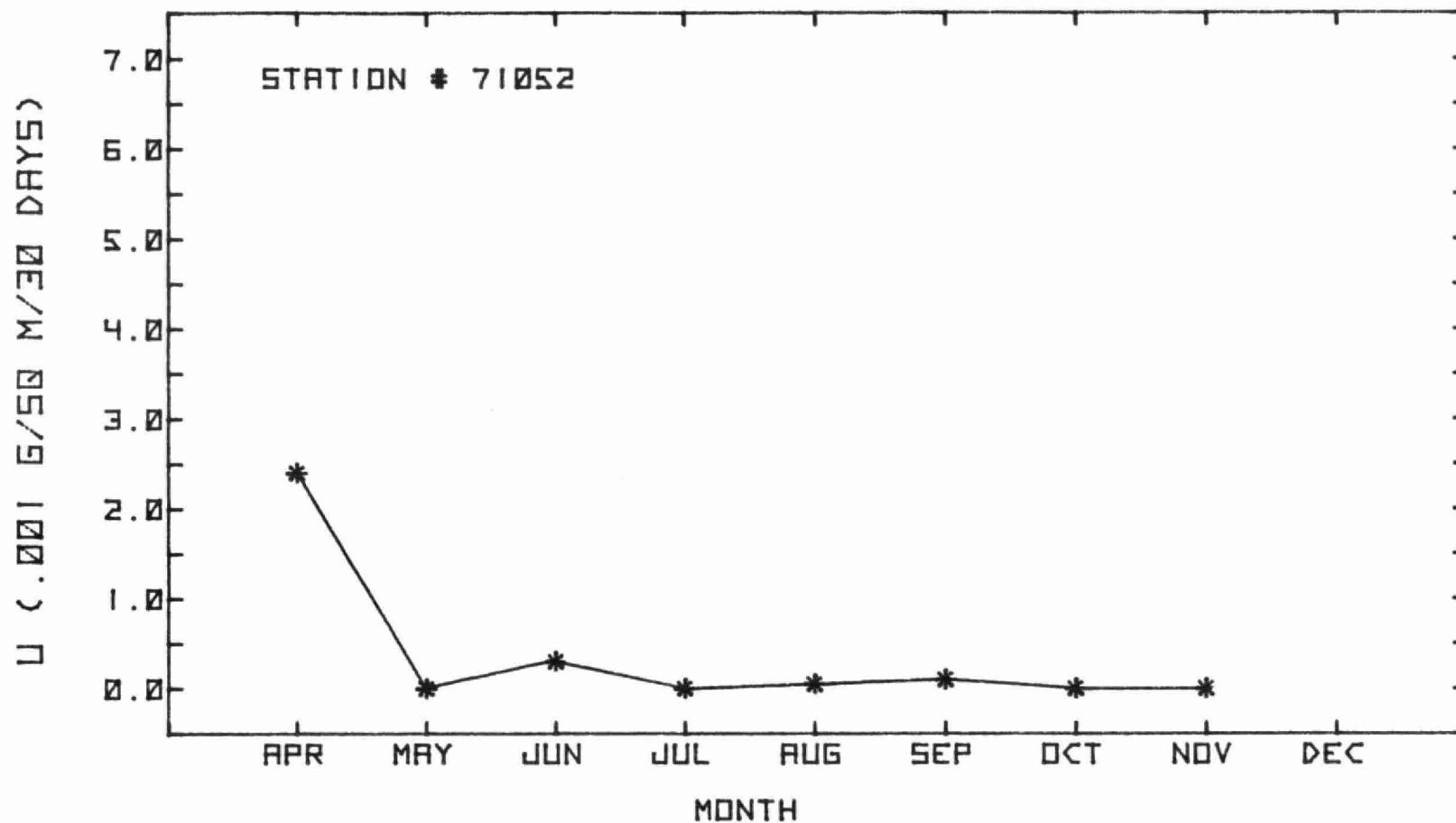


FIGURE: 14

URANIUM IN DUSTFALL FOR THE ELLIOT LAKE AREA, 1981

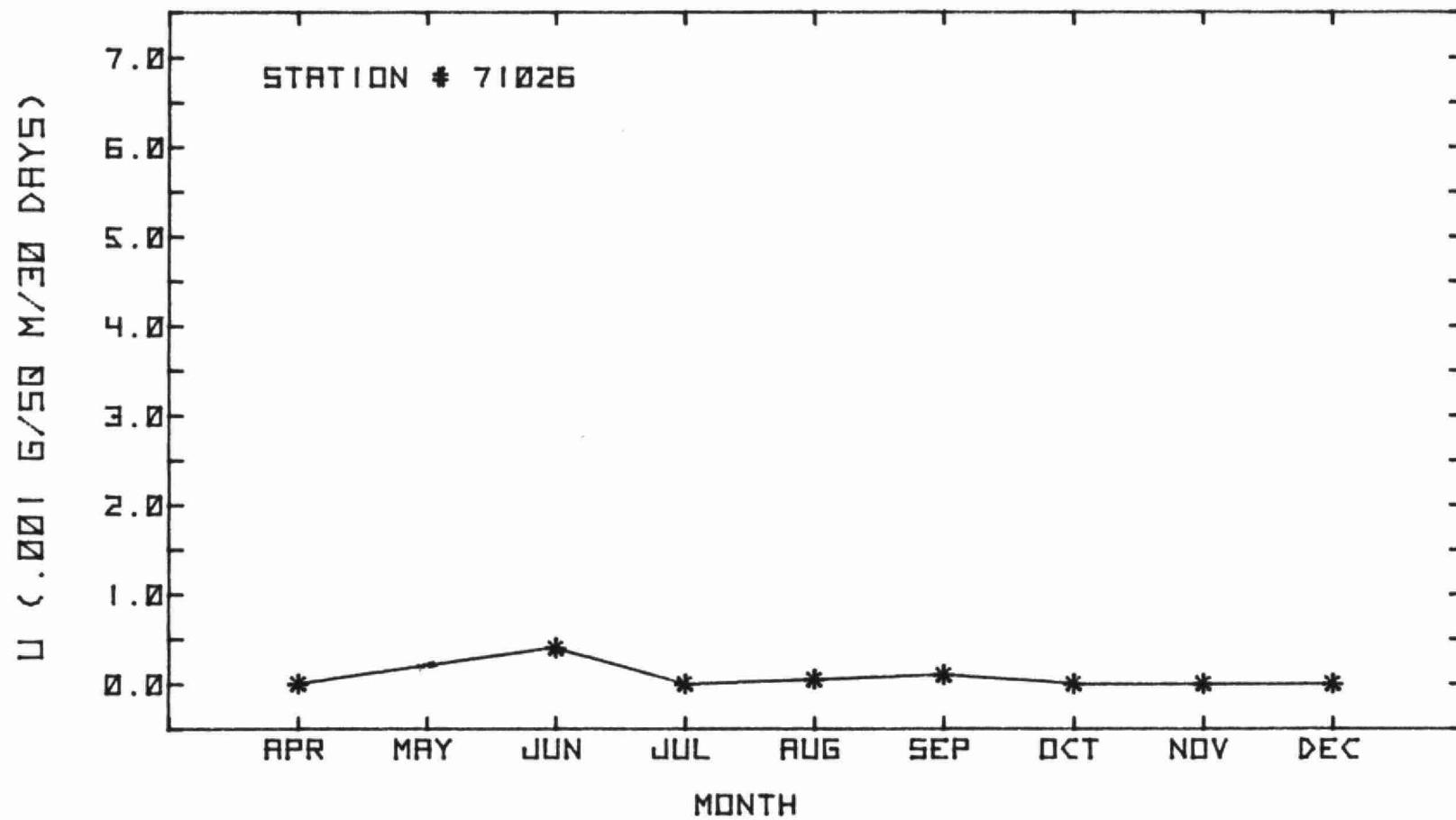


FIG. 15

URANIUM IN DUSTFALL FOR THE ELLIOT LAKE AREA, 1981

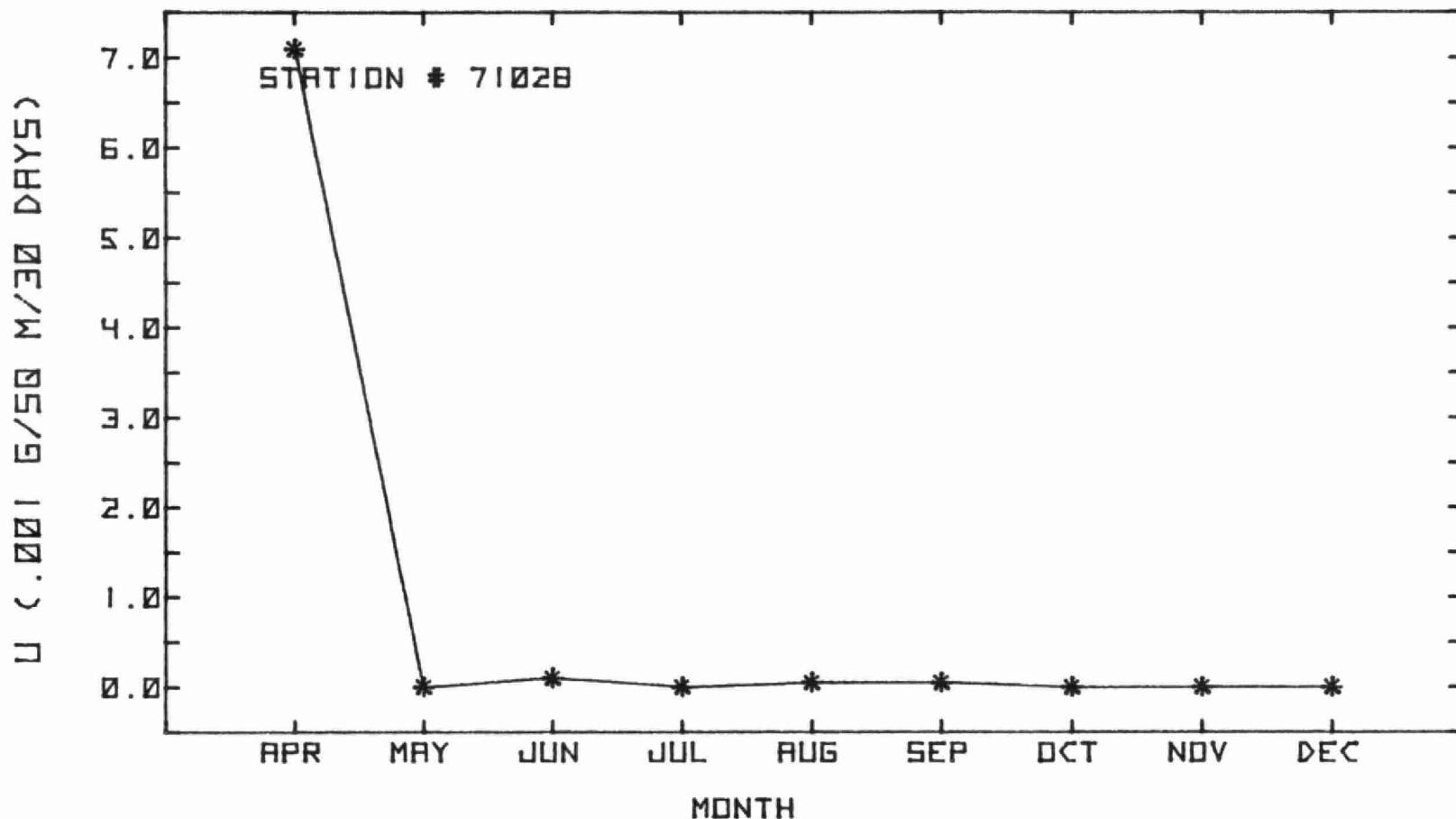


FIG. 16

URANIUM IN DUSTFALL FOR THE ELLIOT LAKE AREA, 1981

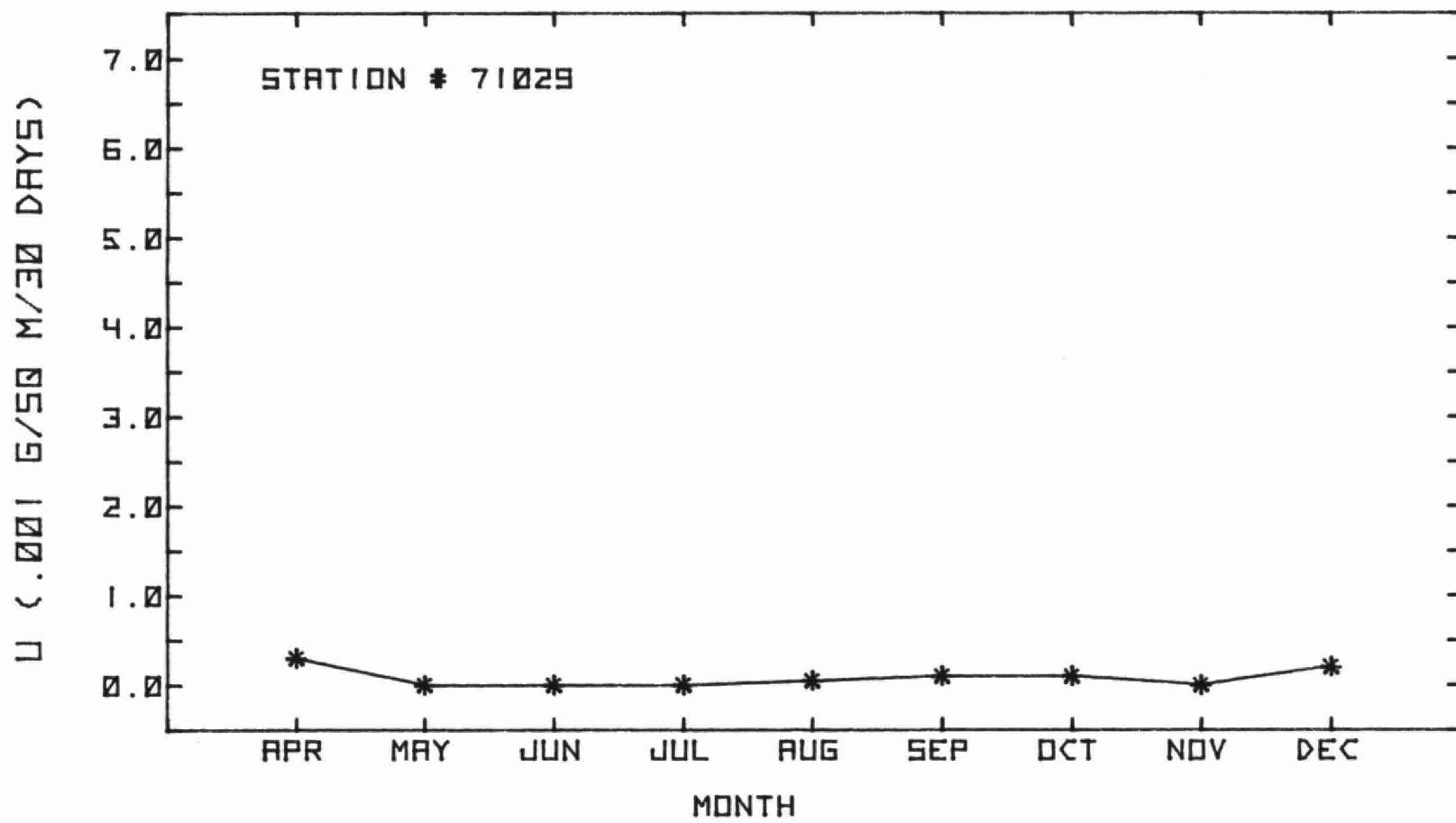


FIG. 17

URANIUM IN DUSTFALL FOR THE ELLIOT LAKE AREA, 1981

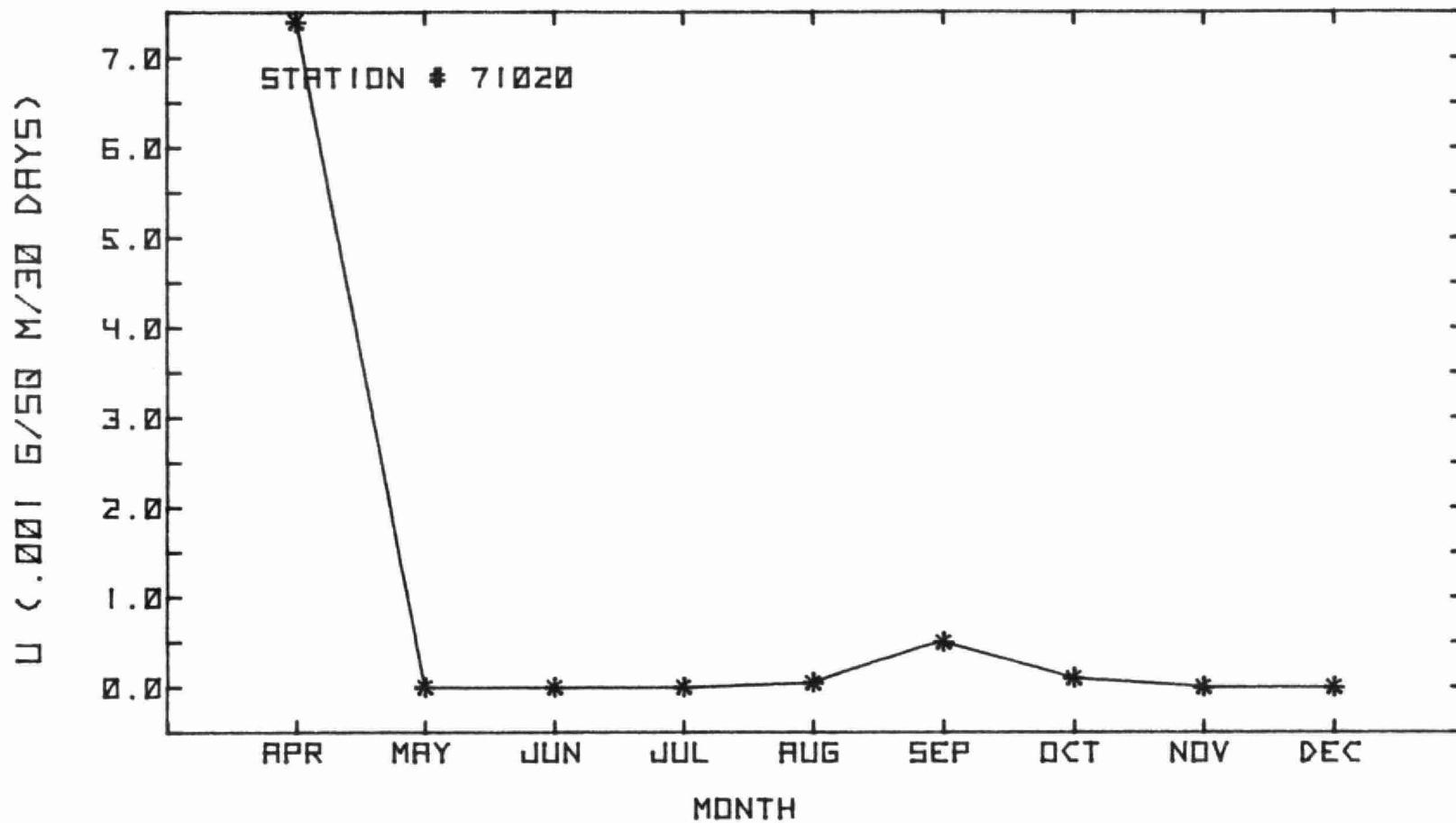


FIG. 18

URANIUM IN DUSTFALL FOR THE ELLIOT LAKE AREA, 1981

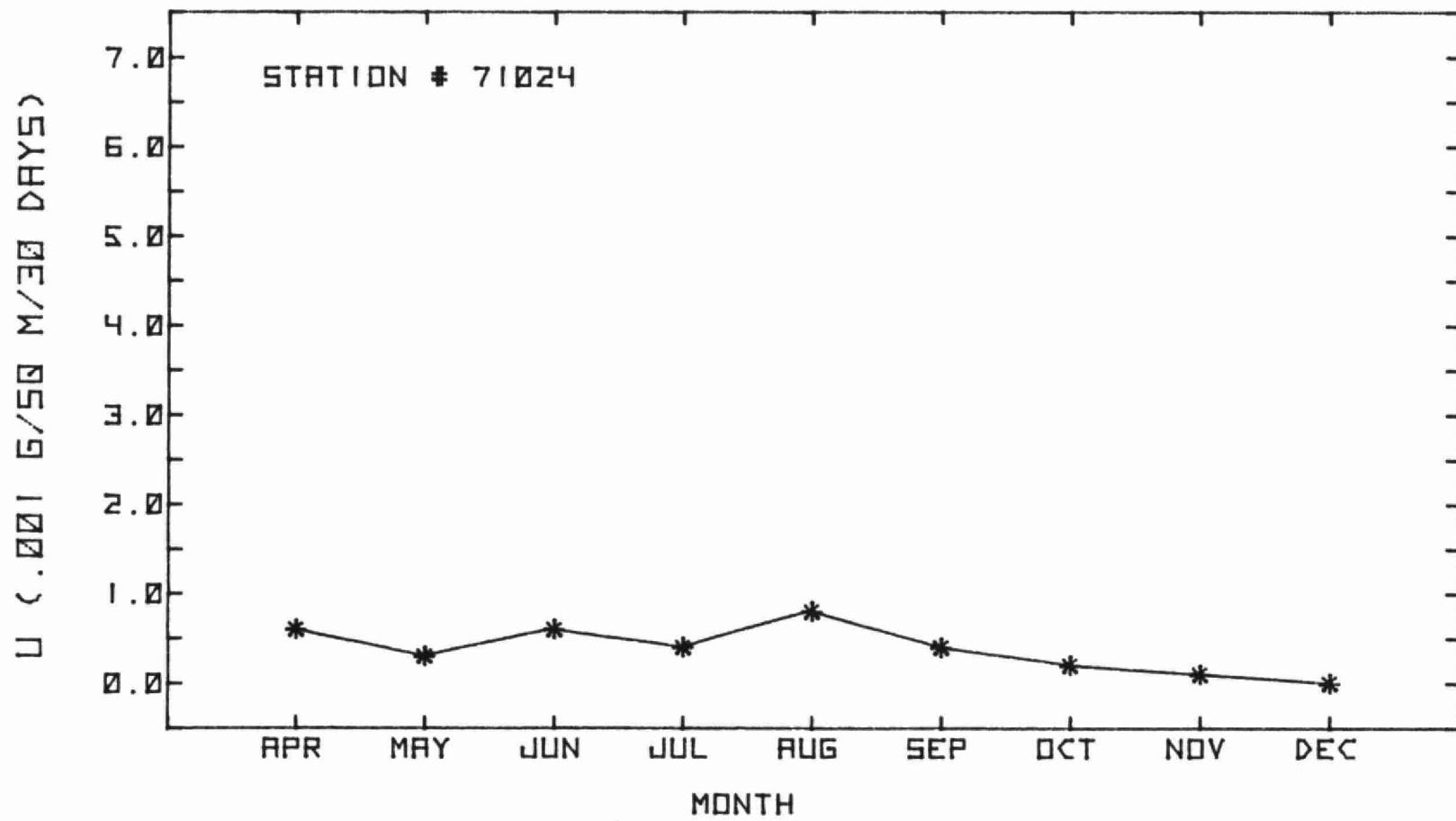


FIG. 19

URANIUM IN DUSTFALL FOR THE ELLIOT LAKE AREA, 1981

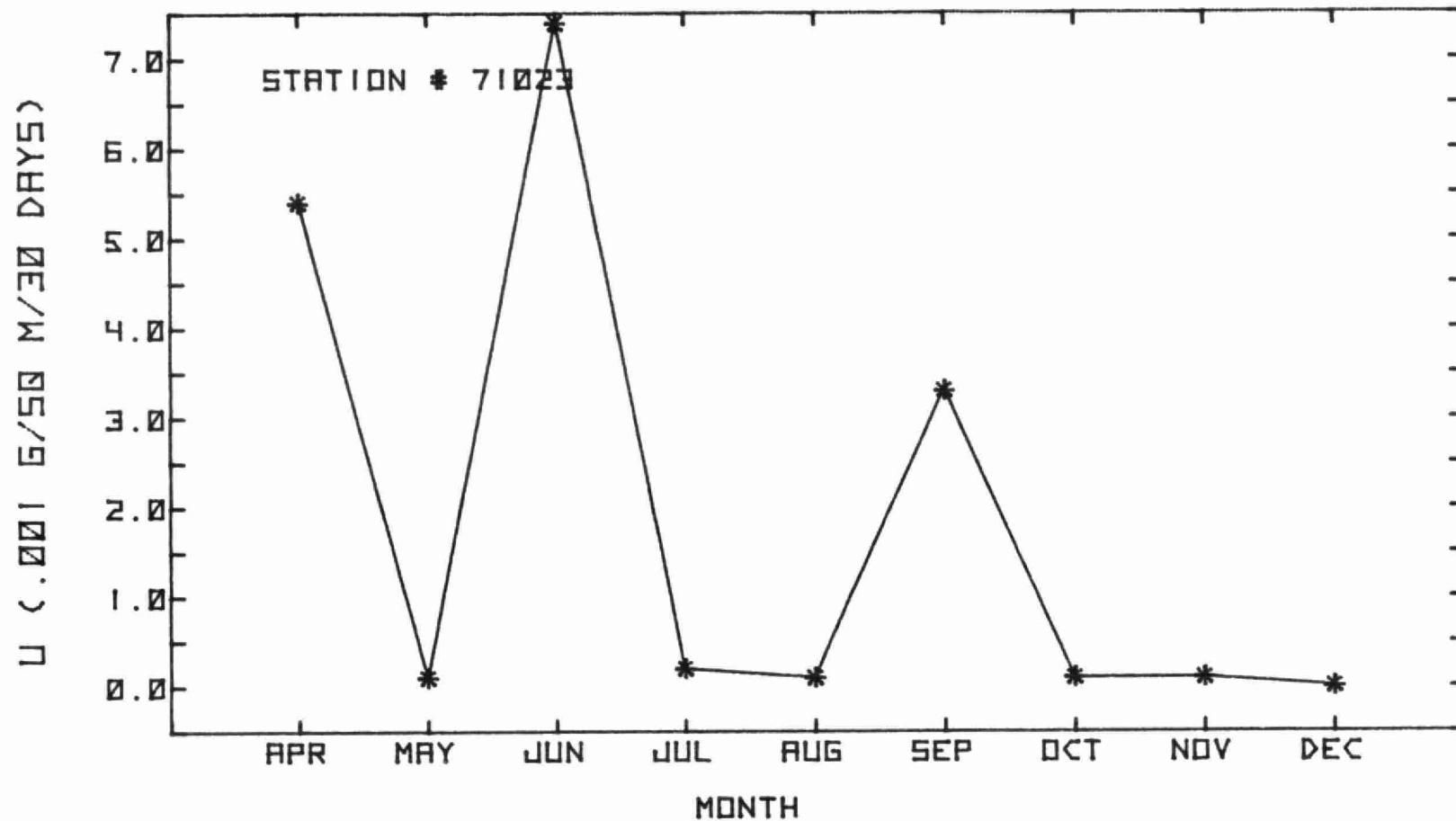


FIG. 20

URANIUM IN DUSTFALL FOR THE ELLIOT LAKE AREA, 1981

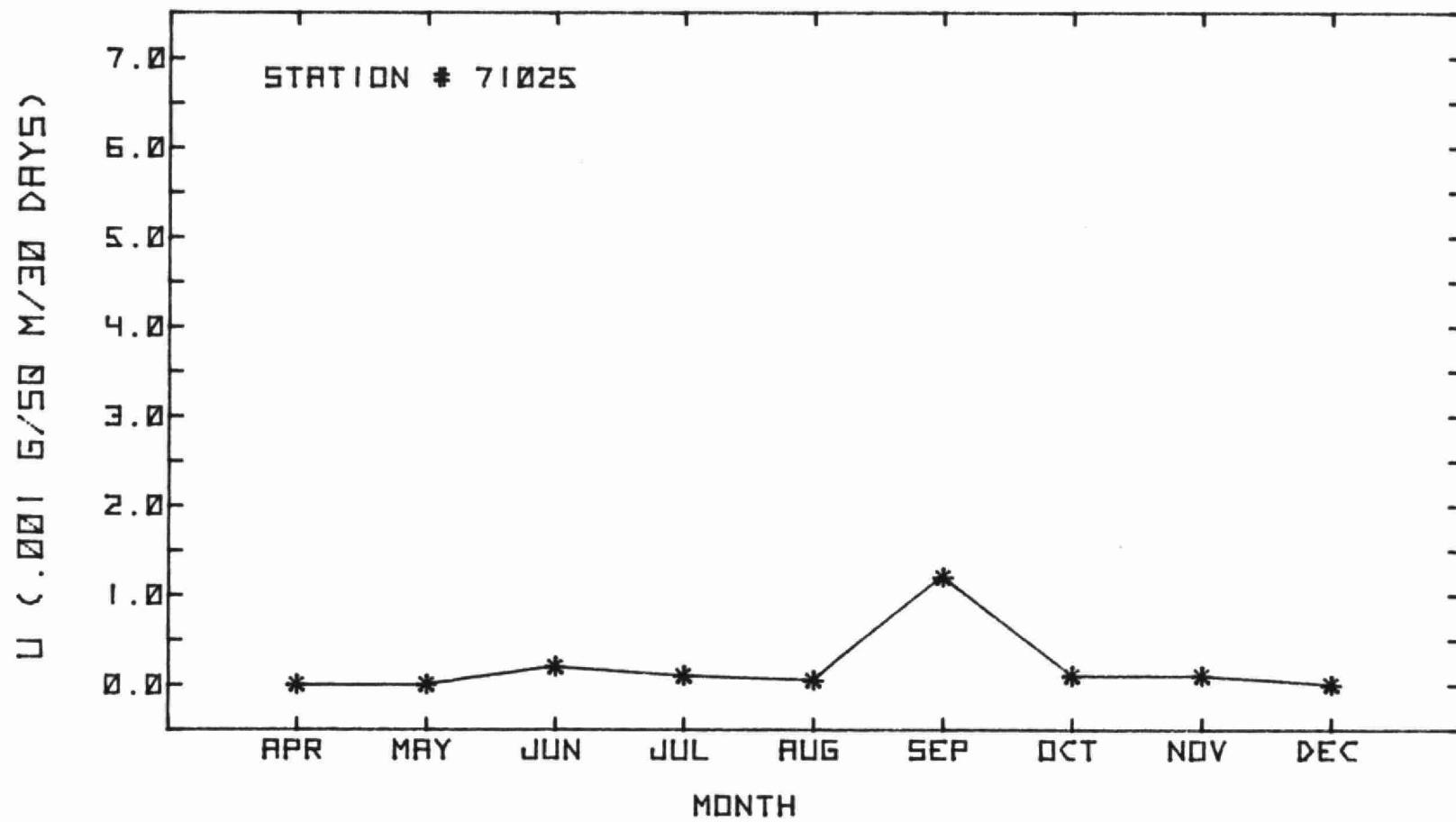


FIG. 21

URANIUM IN DUSTFALL FOR THE ELLIOT LAKE AREA, 1981

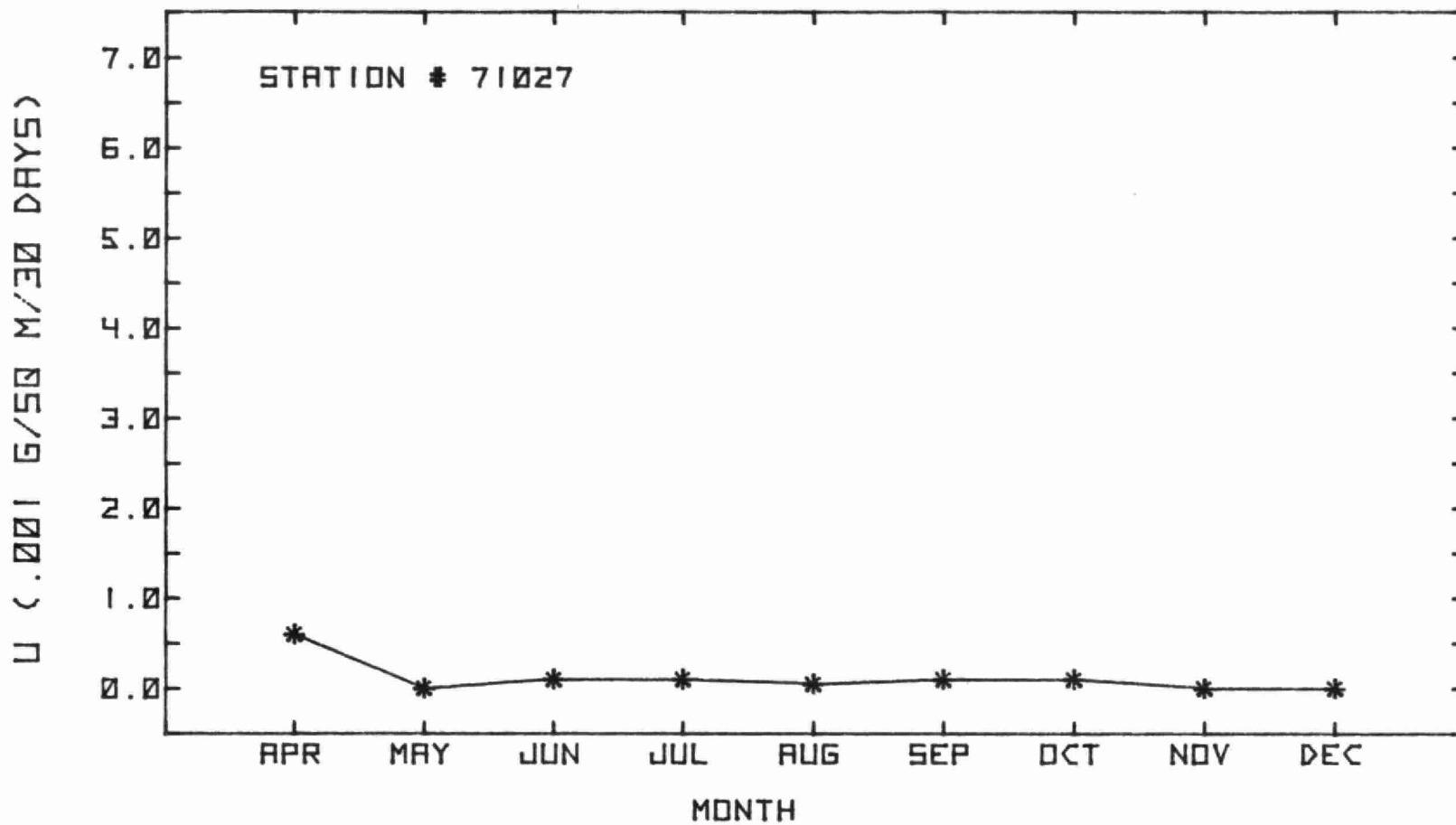


FIG. 22

ANNUAL GEOMETRIC MEAN OF T.S.P. LEVELS COLLECTED IN THE
ELLIOT LAKE AREA

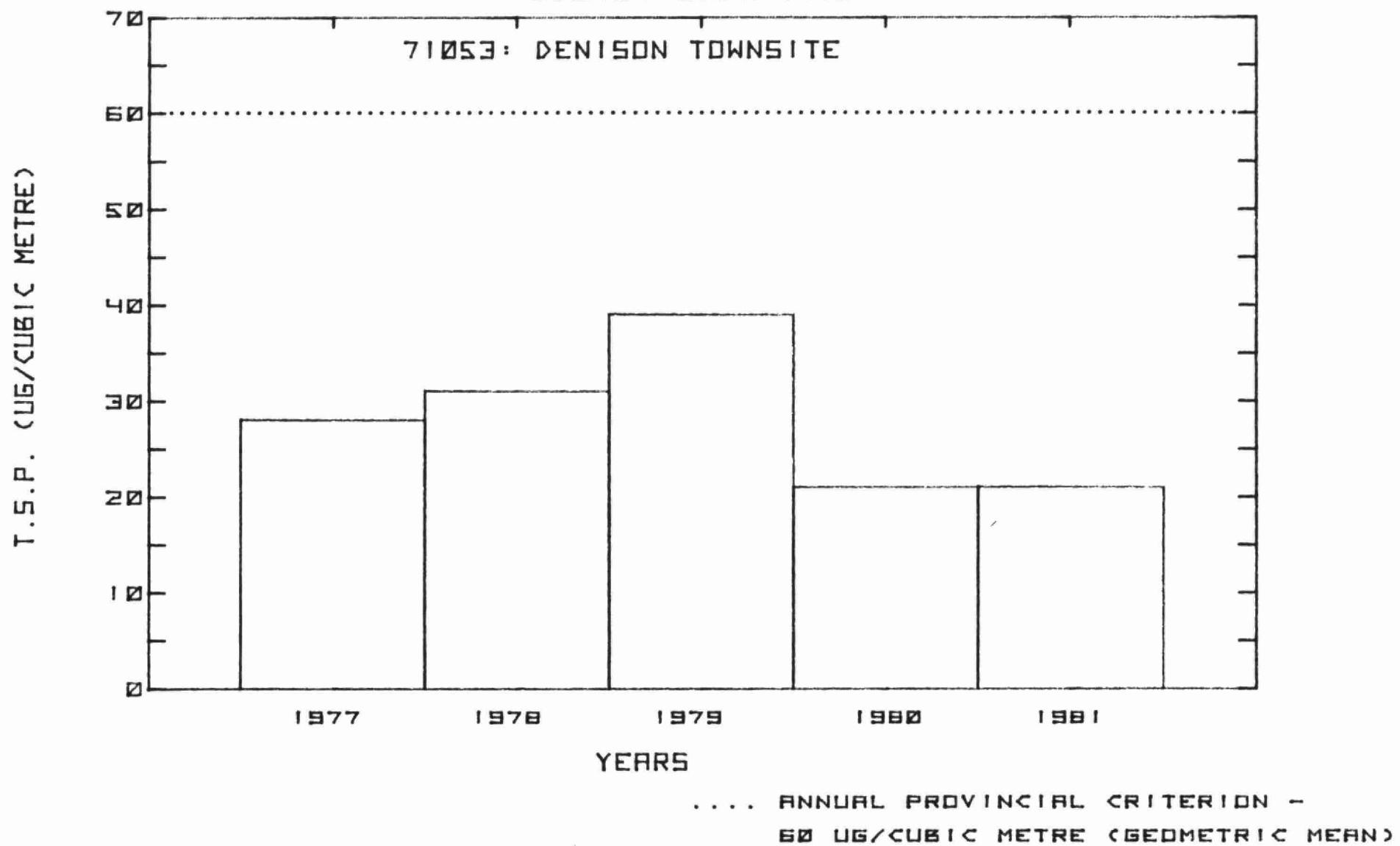


FIG. 23

PERIOD: 1977 TO 1981

ANNUAL GEOMETRIC MEAN OF T.S.P. LEVELS COLLECTED IN THE
ELLiot LAKE AREA

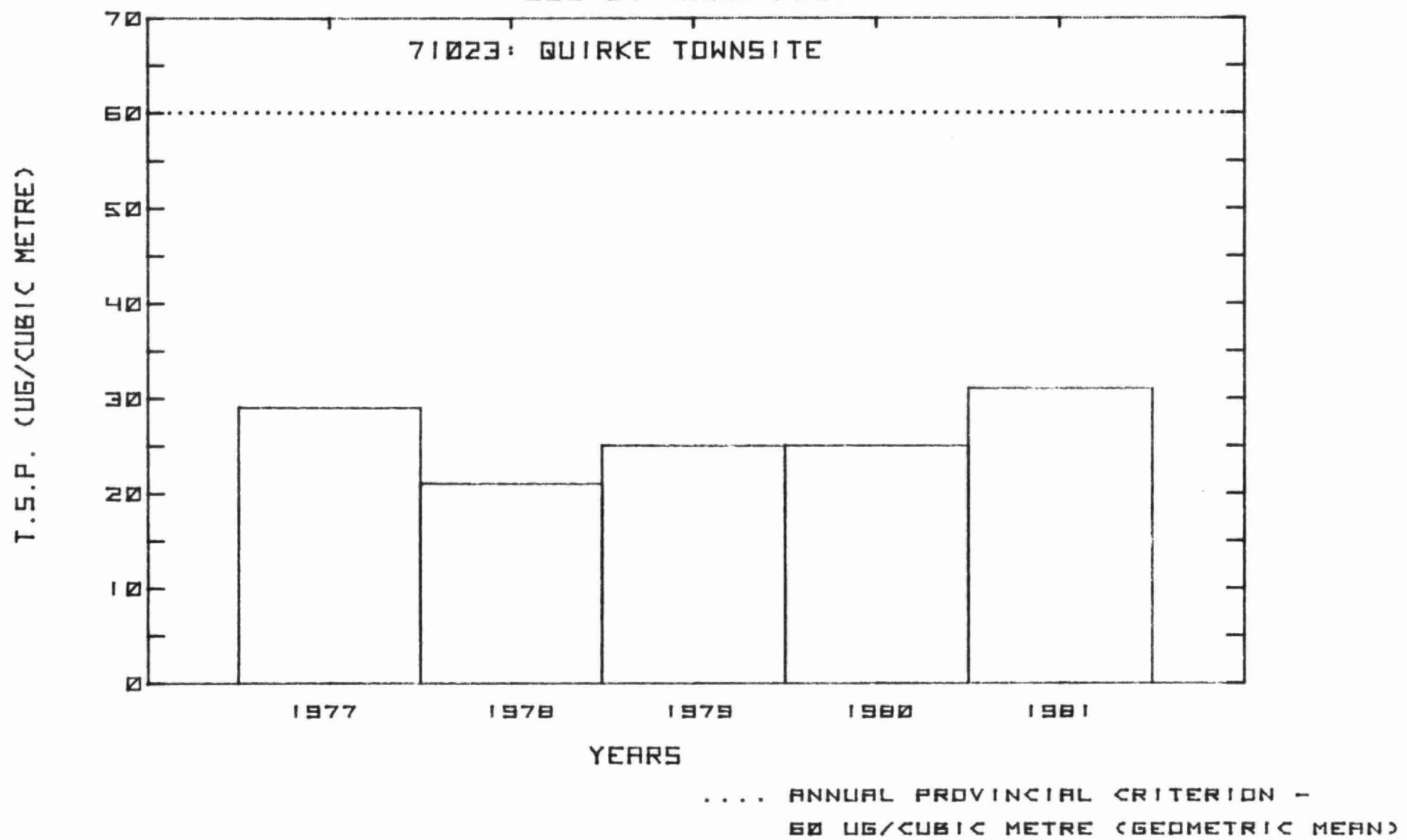


FIG. 24

PERIOD: 1977 TO 1981

ANNUAL GEOMETRIC MEAN OF T.S.P. LEVELS COLLECTED IN THE
ELLIOT LAKE AREA

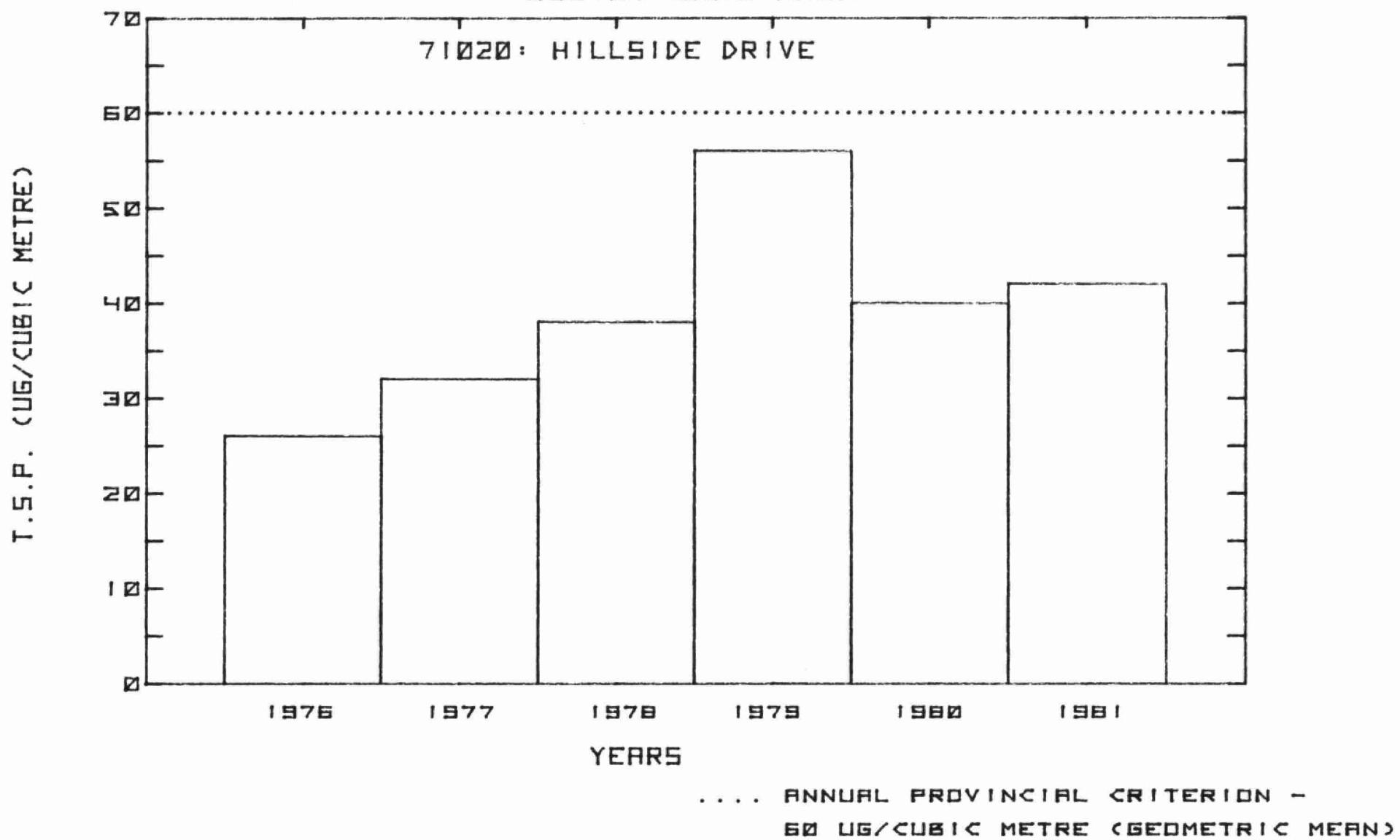
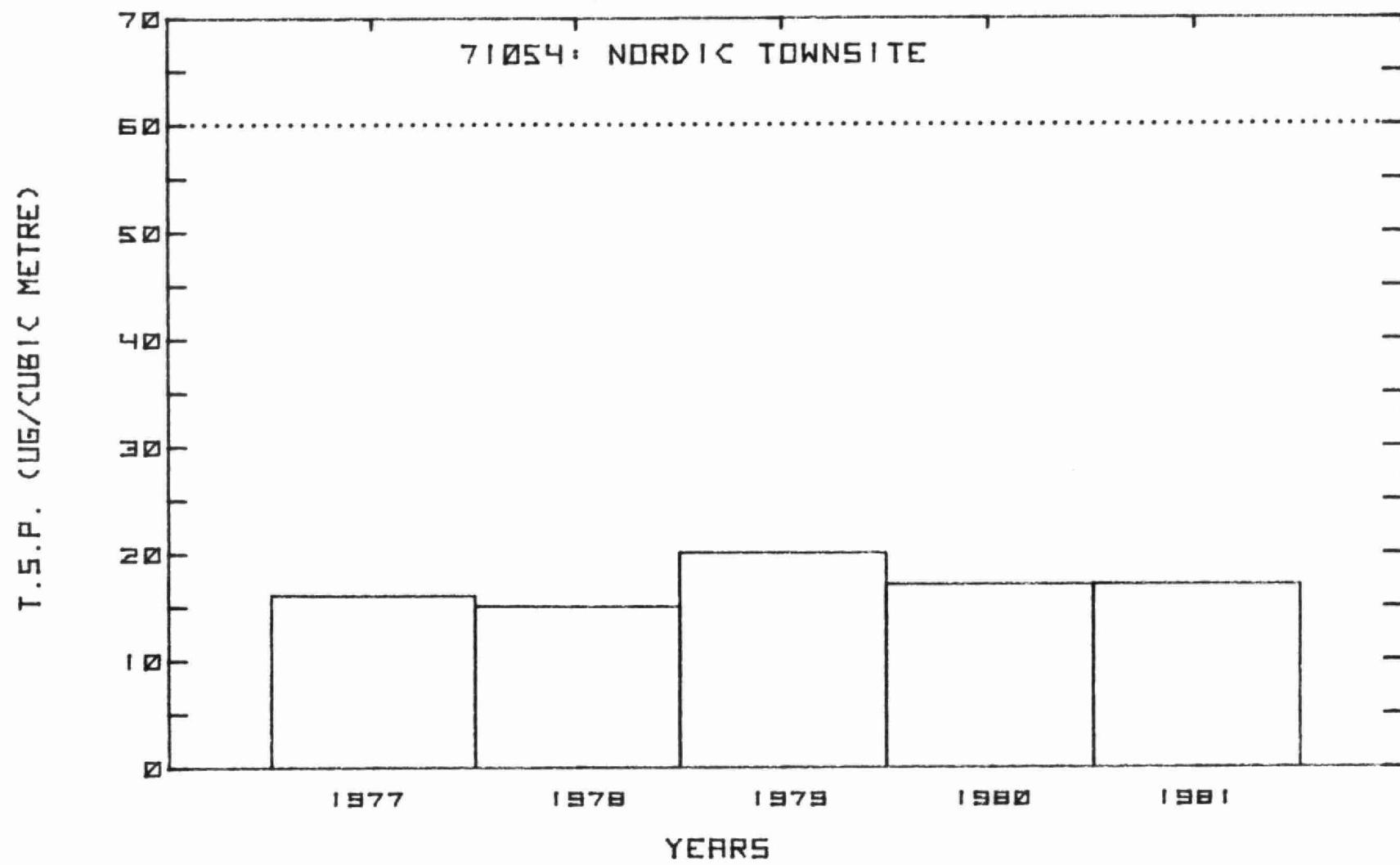


FIG. 25

PERIOD: 1976 TO 1981

ANNUAL GEOMETRIC MEAN OF T.S.P. LEVELS COLLECTED IN THE
ELLIOt LAKE AREA



.... ANNUAL PROVINCIAL CRITERION -
60 UG/CUBIC METRE (GEOMETRIC MEAN)

FIG. 26

PERIOD: 1977 TO 1981

ANNUAL GEOMETRIC MEAN OF T.S.P. LEVELS COLLECTED IN THE
ELLIOT LAKE AREA

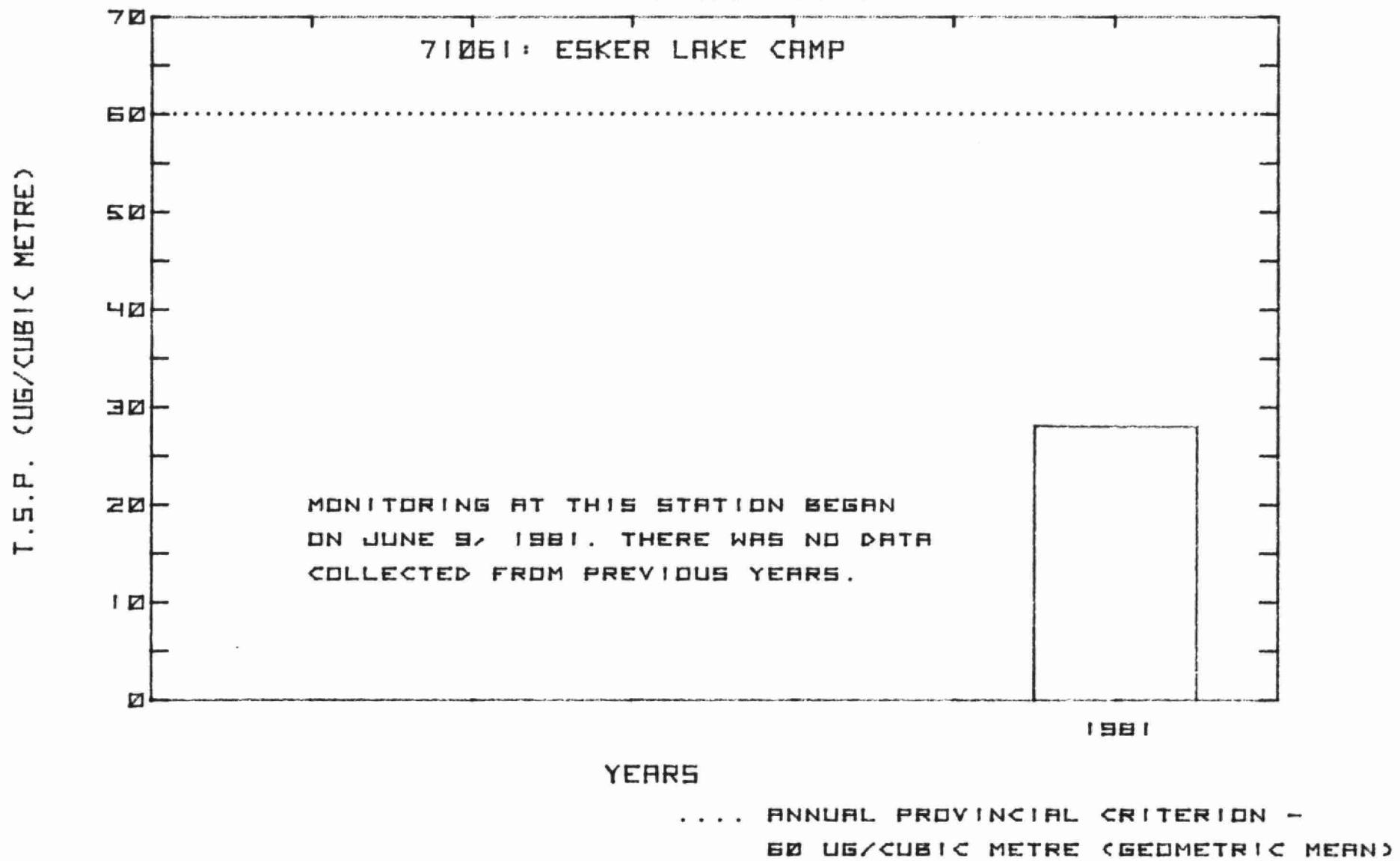


FIG. 27

PERIOD: 1976 TO 1981

ANNUAL GEOMETRIC MEAN OF T.S.P. LEVELS COLLECTED IN THE
ELLIOT LAKE AREA

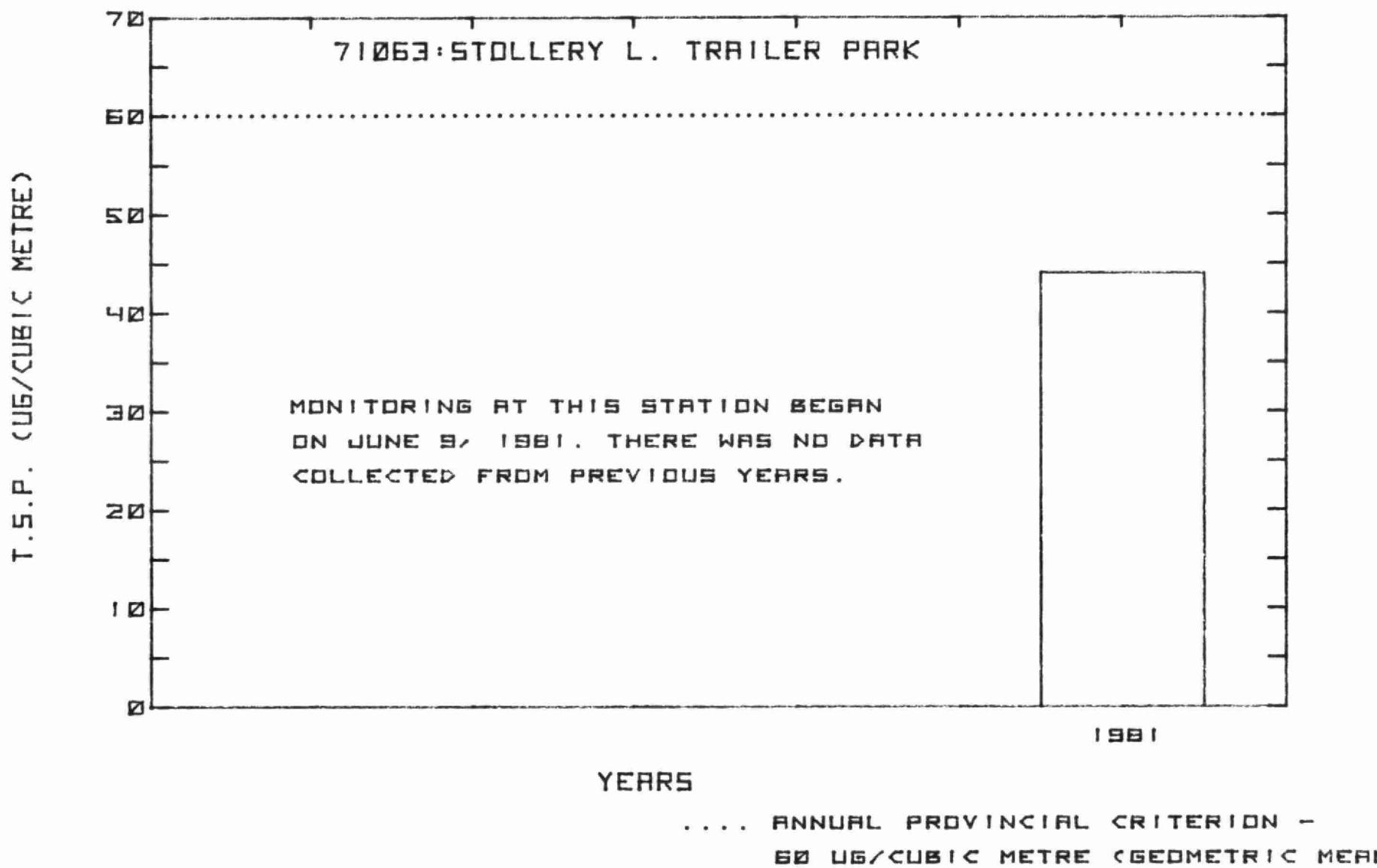
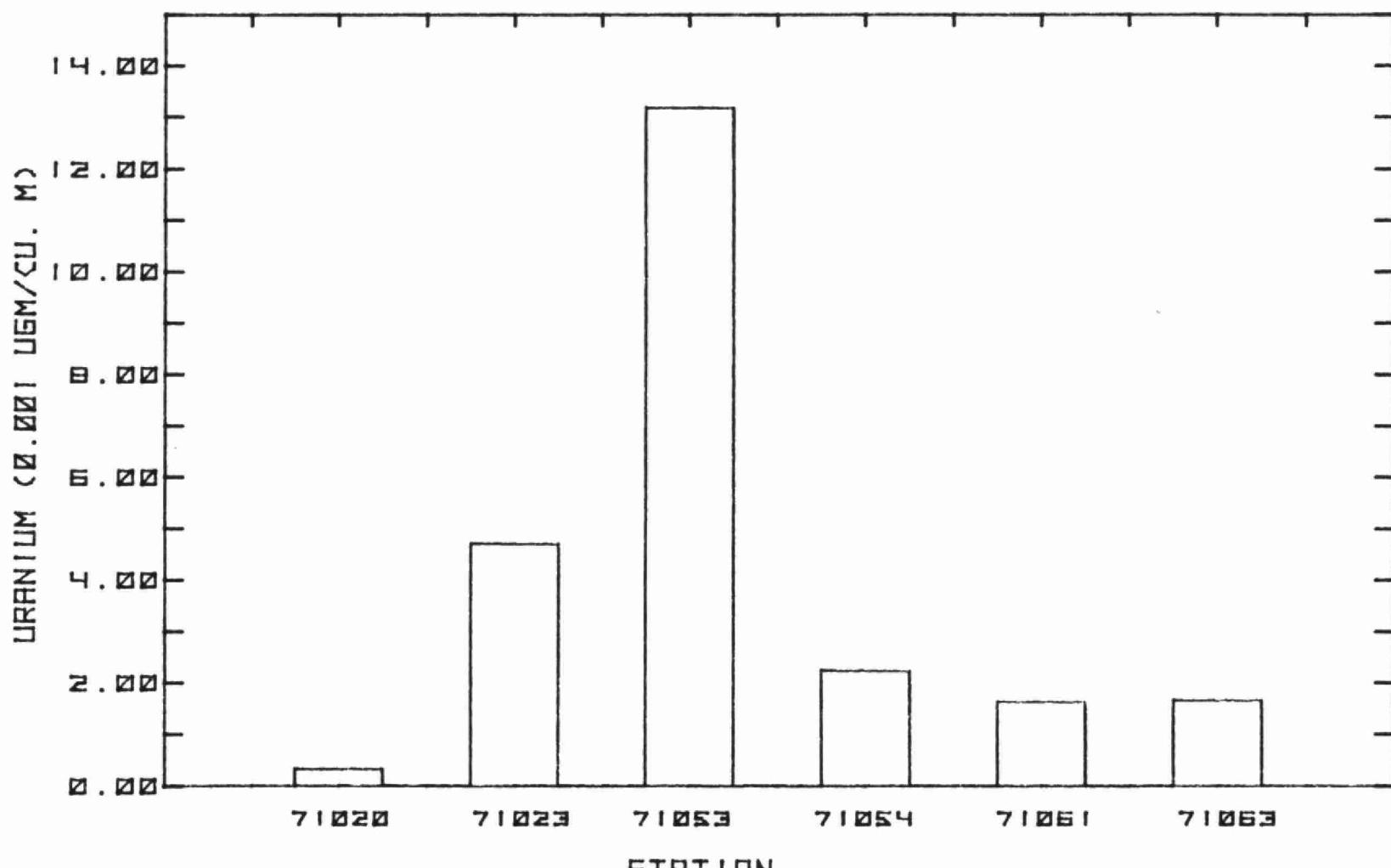


FIG. 28

PERIOD: 1976 TO 1981

ARITHMETIC MEAN OF TOTAL URANIUM IN T.S.P. COLLECTED IN THE
ELLIOT LAKE AREA - 1981

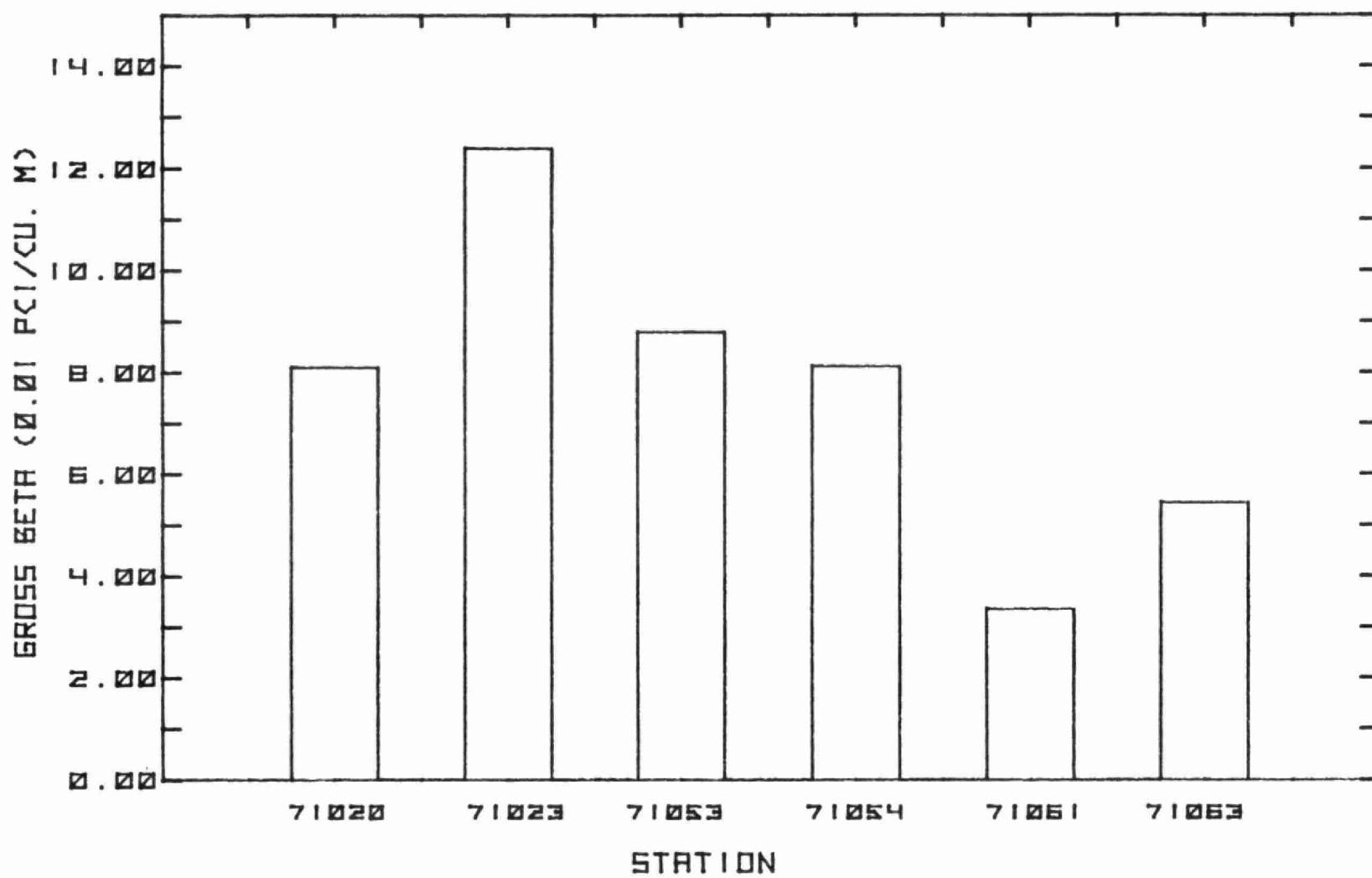


DATA NOT FOR FULL YEAR

NO PROVINCIAL CRITERION

FIG. 29

ARITHMETIC MEAN OF GROSS BETA IN T.S.P. COLLECTED IN THE
ELLIOT LAKE AREA - 1981



DATA NOT FOR FULL YEAR

NO PROVINCIAL CRITERION

6.5 APPENDIX E

DATA REQUESTS AND RESPONSES



Ontario

Ministry Northeastern
of the Region
Environment

1982 01 22.

COPY

199 Larch Street
Sudbury, Ont.
P3E 5P9
(705) 675-4501

Mr. J. H. Aitken,
Chief,
Radiation Protection Service,
Special Studies and Services Branch,
Ministry of Labour,
8th Floor,
434 University Avenue,
Toronto, Ontario.

Dear Sir:

Re: Ambient Air Monitoring Data,
Elliot Lake Area - 1981.

As was outlined in Dr. Balsillie's letter of January 26, 1981, recommendation 12-7 of the Final Report of the Environmental Assessment Board regarding the Expansion of Uranium Mines in the Elliot Lake area states that:

"...All data obtained from the air quality monitoring programs of the companies and the province be exchanged and be available to the public".

The data collected from 1976 to 1980 was published in 1981 in a report entitled "Air Quality Assessment Studies Carried Out in the Elliot Lake Area, 1976 to 1980". I am therefore requesting that all available data collected in 1981 be forwarded to the Sudbury Office of the Ministry of the Environment. The Ministry will then undertake to compile, collate and publish this data.

I would request that raw data not be forwarded this year but that a summary similar to that prepared by the Ministry of the Environment in Appendix A of the Elliot Lake Report be submitted instead.

It is our intention to have this data published early in 1982 so we would appreciate receiving the summaries as soon as they are available.

Yours very truly,

D. J. Bazinet,
Air Quality Analyst.

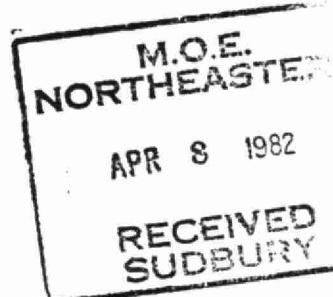
DJB/sgl/M-R14

C.C.: [REDACTED]



Ontario
Ministry of
Labour

RADIATION PROTECTION SERVICE
SPECIAL STUDIES AND SERVICES
8th floor
400 University Avenue
Toronto, Ontario M7A 1T7
Tel: (416) 965-8178



April 5, 1982

Mr. D.J. Bazinet
Air Quality Analyst
Northeastern Region
Ministry of the Environment
199 Larch St.
Sudbury, Ontario
P3E 5P9

Dear Mr. Bazinet:

Re: Ambient Air Monitoring Data
Elliot Lake Area, 1981

I have enclosed the outdoor monitoring data from the Elliot Lake area obtained in 1981. Both Mr. A. Vivyurka of Rio Algom Ltd. and Mr. J.L. Chakravatti of Denison Mines Ltd. agreed that I could send the respective data directly to you and are aware that the data will be published in the "Yearly Summary".

I have also enclosed data obtained from the outdoor monitor at 1 Lawrence Ave. in Lakeside Estates. These Radon daughter concentrations are not very different from those found at the monitor on the Municipal Building. Monitoring at this site will continue until we hear otherwise from you.

Yours truly,

D.A. Marsden, Ph.D.
Consultant
Environmental Radioactivity

ATT.
DAM/jc



Ontario

Ministry Northeastern
of the Region
Environment

1982 01 22.

COPY

199 Larch Street
Sudbury, Ont.
P3E 5P9
(705) 675-4501

Mr. A. Rickaby,
General Manager,
Denison Mines Limited,
P. O. Box 2600,
Elliot Lake, Ontario.
P5A 2K2

Dear Sir:

Re: Ambient Air Monitoring Data,
Elliot Lake Area - 1981.

As was outlined in Dr. Balsillie's letter of January 26, 1981, recommendation 12-7 of the Final Report of the Environmental Assessment Board regarding the Expansion of Uranium Mines in the Elliot Lake area states that:

"...All data obtained from the air quality monitoring programs of the companies and the province be exchanged and be available to the public".

The data collected from 1976 to 1980 was published in 1981 in a report entitled "Air Quality Assessment Studies Carried Out in the Elliot Lake Area, 1976 to 1980". I am therefore requesting that all available data collected in 1981 be forwarded to the Sudbury Office of the Ministry of the Environment. The Ministry will then undertake to compile, collate and publish this data.

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Yours very truly,

D. J. Bazinet,
Air Quality Analyst.

DJB/sgl/M-R14

c.c.: [REDACTED]



DENISON MINES LIMITED

BOX B-2600, ELLIOT LAKE, ONTARIO P5A 2K2 TELEPHONE (705)848-9111 TELEX 067-7511

March 30, 1982.

Mr. D. J. Bazinet,
Air Quality Analyst,
Northeastern Region,
Ontario Ministry of the Environment,
199 Larch Street,
Sudbury, Ontario,
P3E 5P9.

Dear Mr. Bazinet:

Thank you for your letter, dated January 22, 1982, regarding Air Quality Monitoring Data collected at Denison Mines Limited operation in 1981.

We trust the enclosed information will satisfy your requirements. If you have any questions, please contact us.

Yours sincerely,

J. L. Chakravatti

J. L. Chakravatti,
Sr. Environmental Engineer.

JLC/lc

Encl.

c.c. A. C. Rickaby



Ontario

Ministry Northeastern
of the Region
Environment

1982 01 22.

COPY

199 Larch Street
Sudbury, Ont.
P3E 5P9
(705) 675-4501

Mr. K. B. Culver,
Manager,
Technical Services,
Rio Algom Limited,
P. O. Box 1500,
Elliot Lake, Ontario.
P5A 2K1

Dear Sir:

Re: Ambient Air Monitoring Data,
Elliot Lake Area - 1981.

As was outlined in Dr. Balsillie's letter of January 26, 1981, recommendation 12-7 of the Final Report of the Environmental Assessment Board regarding the Expansion of Uranium Mines in the Elliot Lake area states that:

"...All data obtained from the air quality monitoring programs of the companies and the province be exchanged and be available to the public".

The data collected from 1976 to 1980 was published in 1981 in a report entitled "Air Quality Assessment Studies Carried Out in the Elliot Lake Area, 1976 to 1980". I am therefore requesting that all available data collected in 1981 be forwarded to the Sudbury Office of the Ministry of the Environment. The Ministry will then undertake to compile, collate and publish this data.

I would request that raw data not be forwarded this year but that a summary similar to that prepared by the Ministry of the Environment in Appendix A of the Elliot Lake Report be submitted instead.

It is our intention to have this data published early in 1982 so we would appreciate receiving the summaries as soon as they are available.

Yours very truly,

D. J. Bazinet,
Air Quality Analyst.

DJB/sgl/M-R14

c.c.: [REDACTED]

Rio Algom Limited

January 28, 1982

Mr. D. J. Bazinet
Air Quality Analyst
Ontario Ministry of Environment
199 Larch Street
Sudbury, Ontario
P3E 5P9

Dear Mr. Bazinet:

Subject: Ambient Air Monitoring Data -
Elliot Lake Area - 1981

In reply to your letter of January 22, 1982 requesting available data on ambient air monitoring collected by Rio Algom Limited during 1981, I wish to inform you that we do not have any data as we did not do any ambient air monitoring.

Yours truly,

RIO ALGOM LIMITED

K. B. Culver

K. B. Culver, P. Eng.
Manager, Technical Services

KBC/cs

x.c. A. Vivyurka

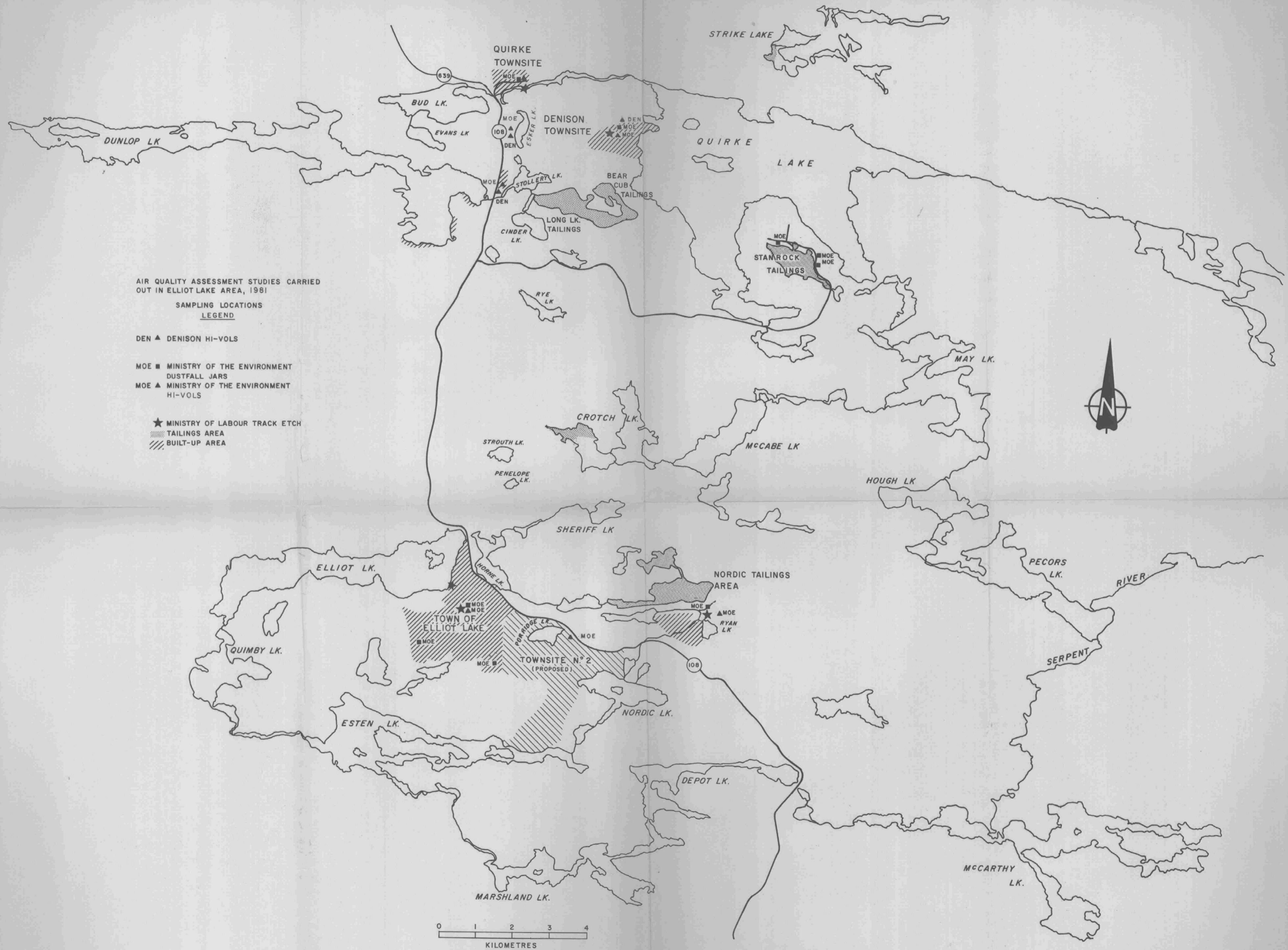


Figure 1

